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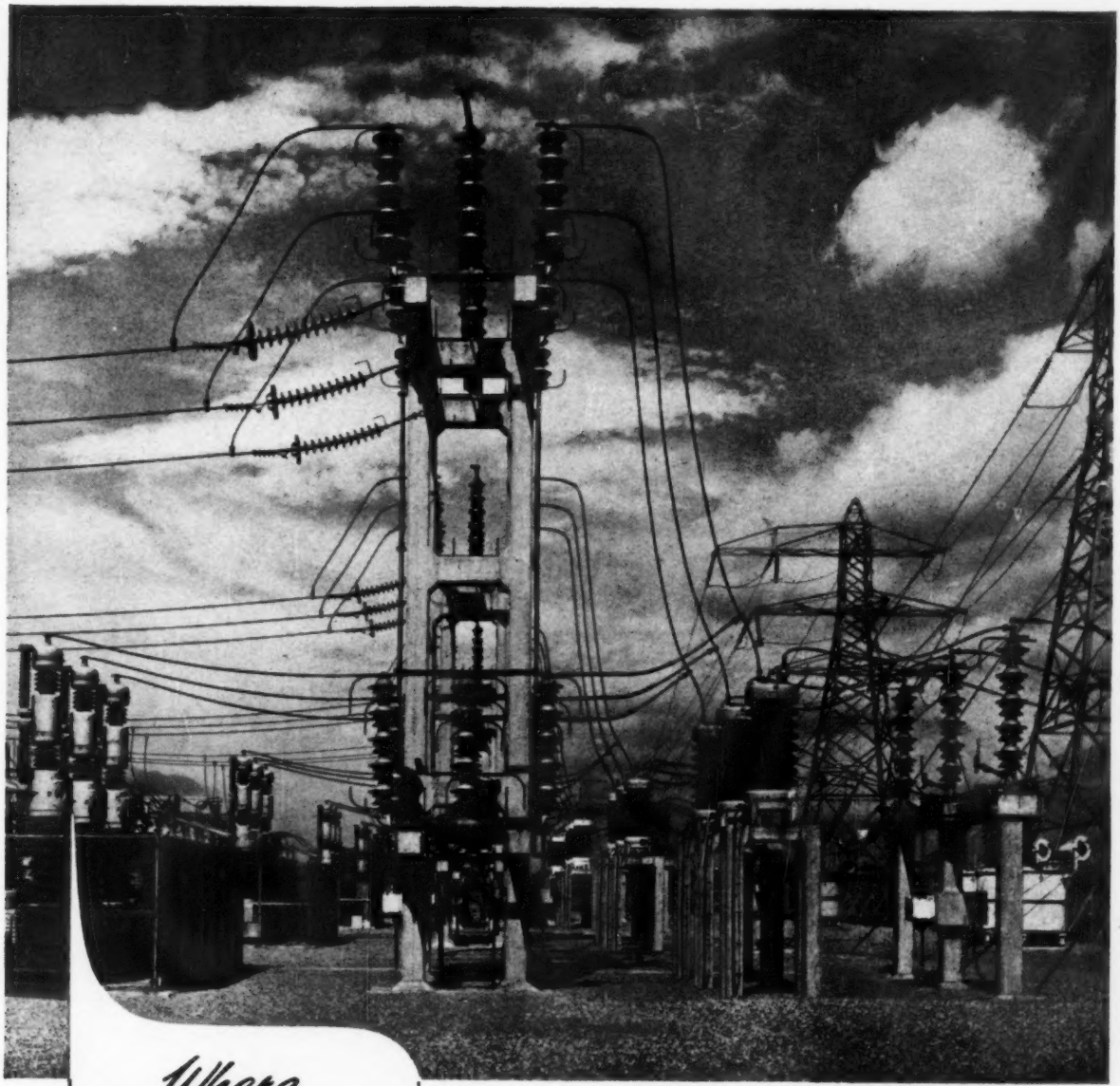

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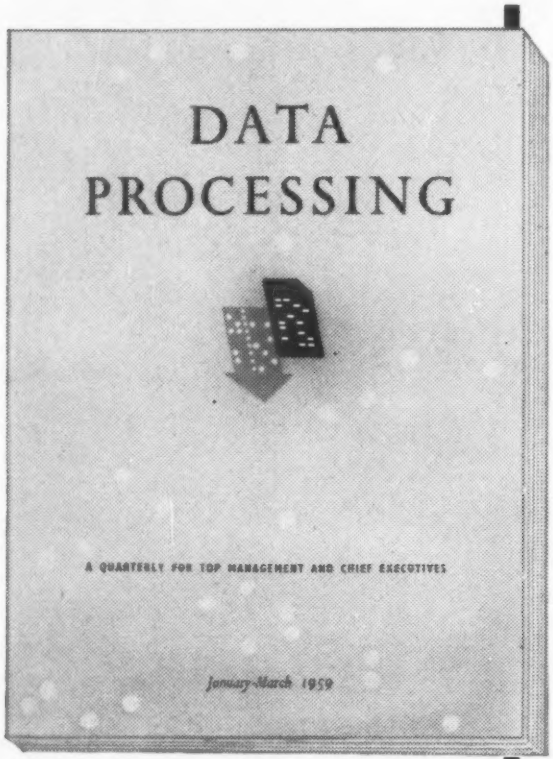

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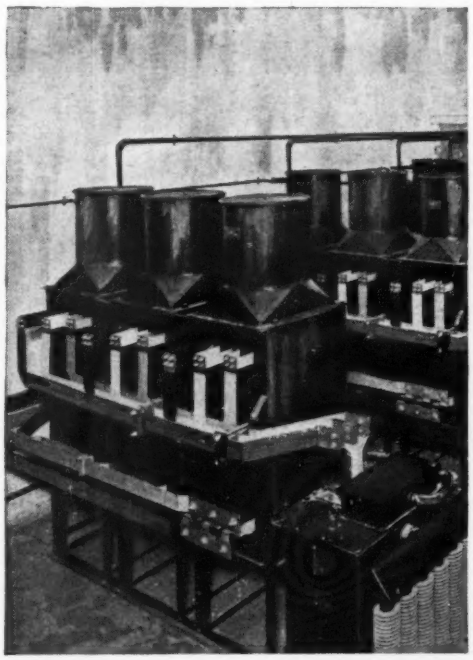

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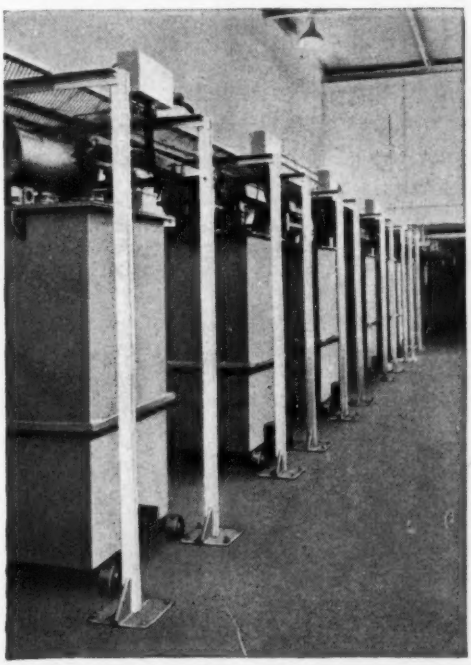

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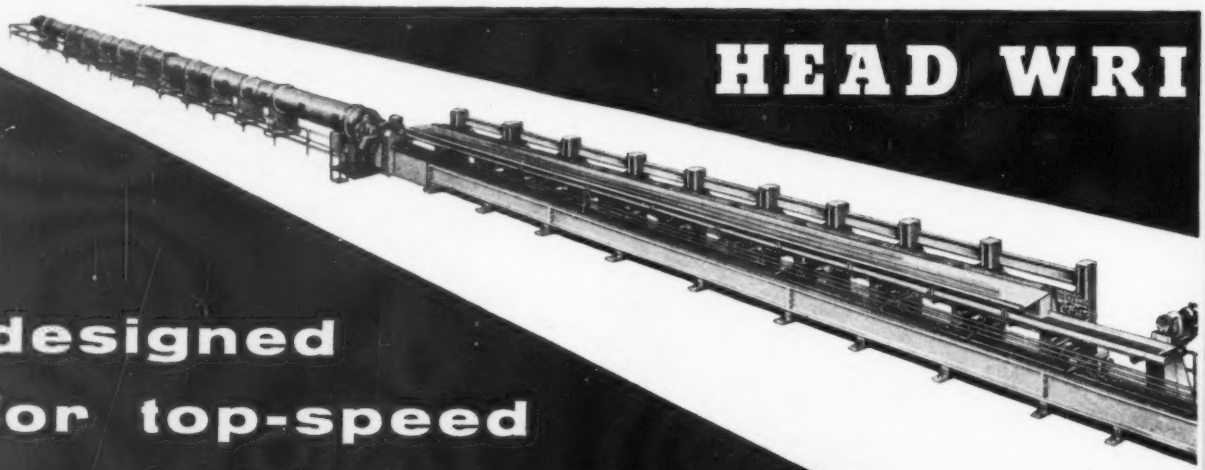

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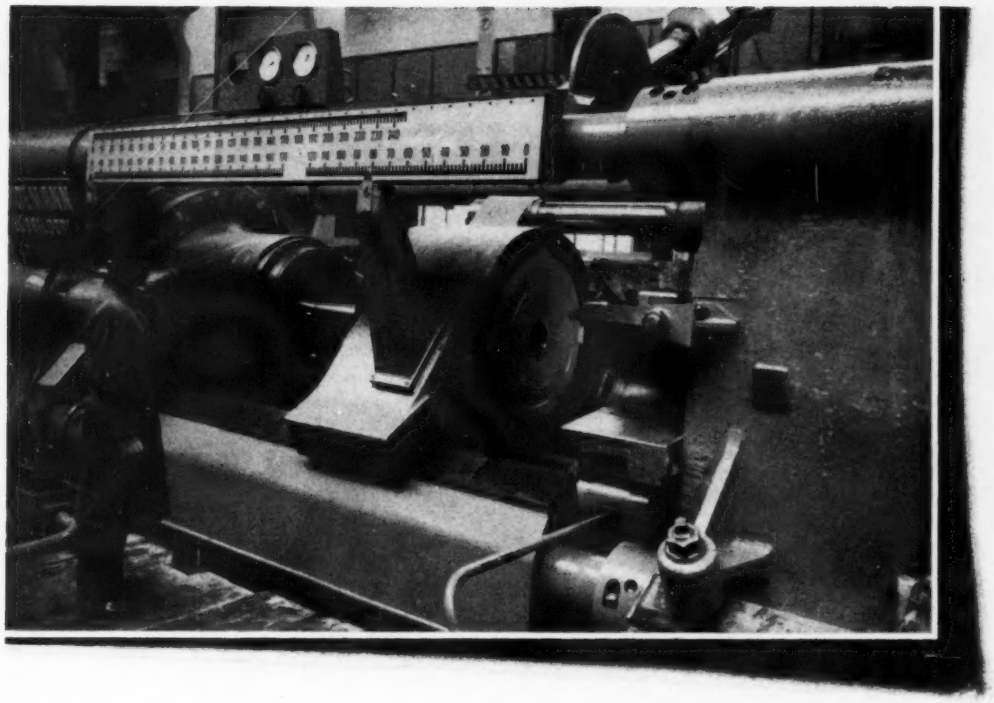

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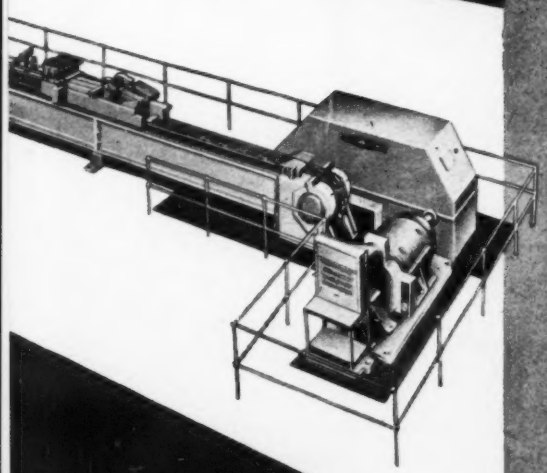

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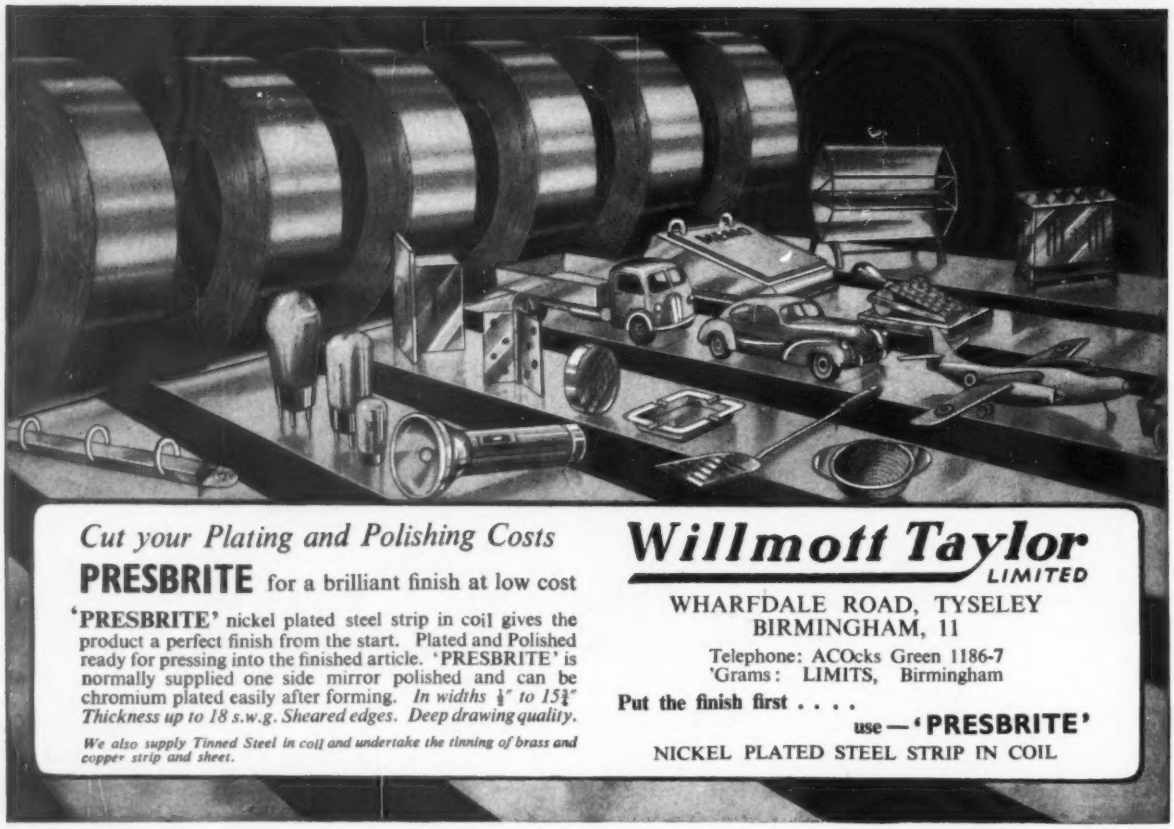

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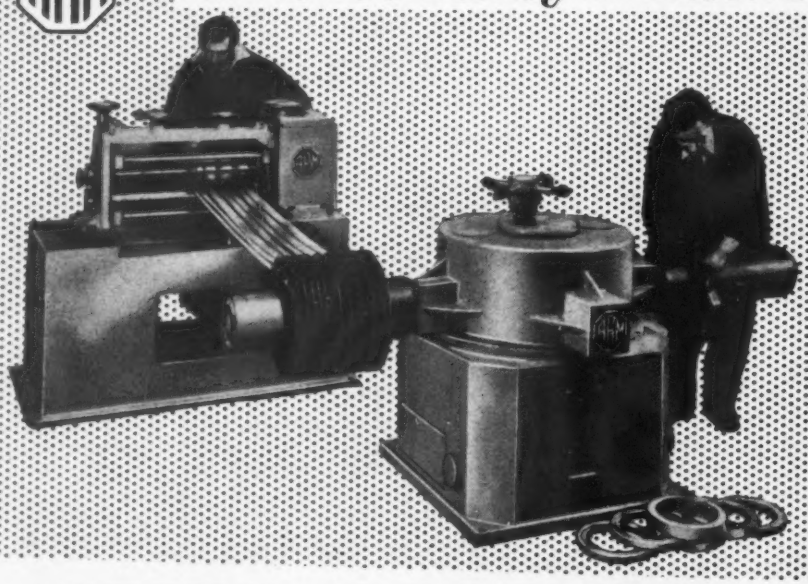

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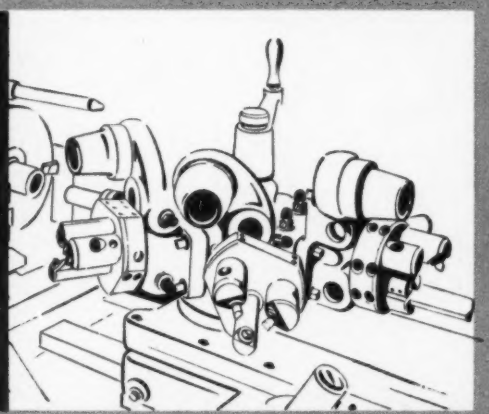

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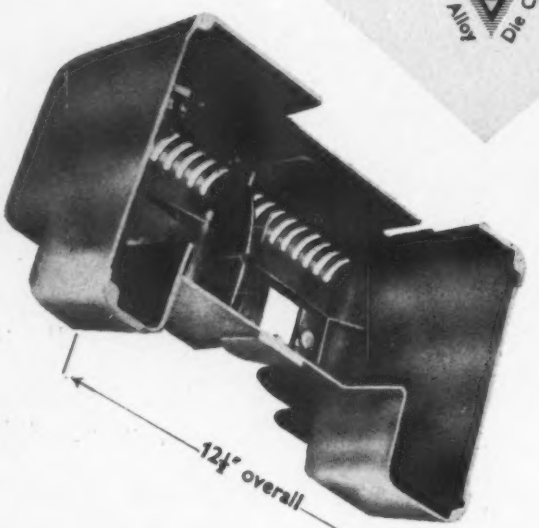

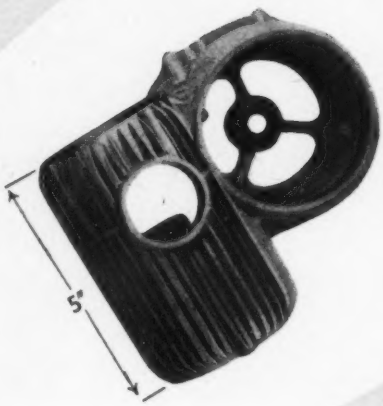

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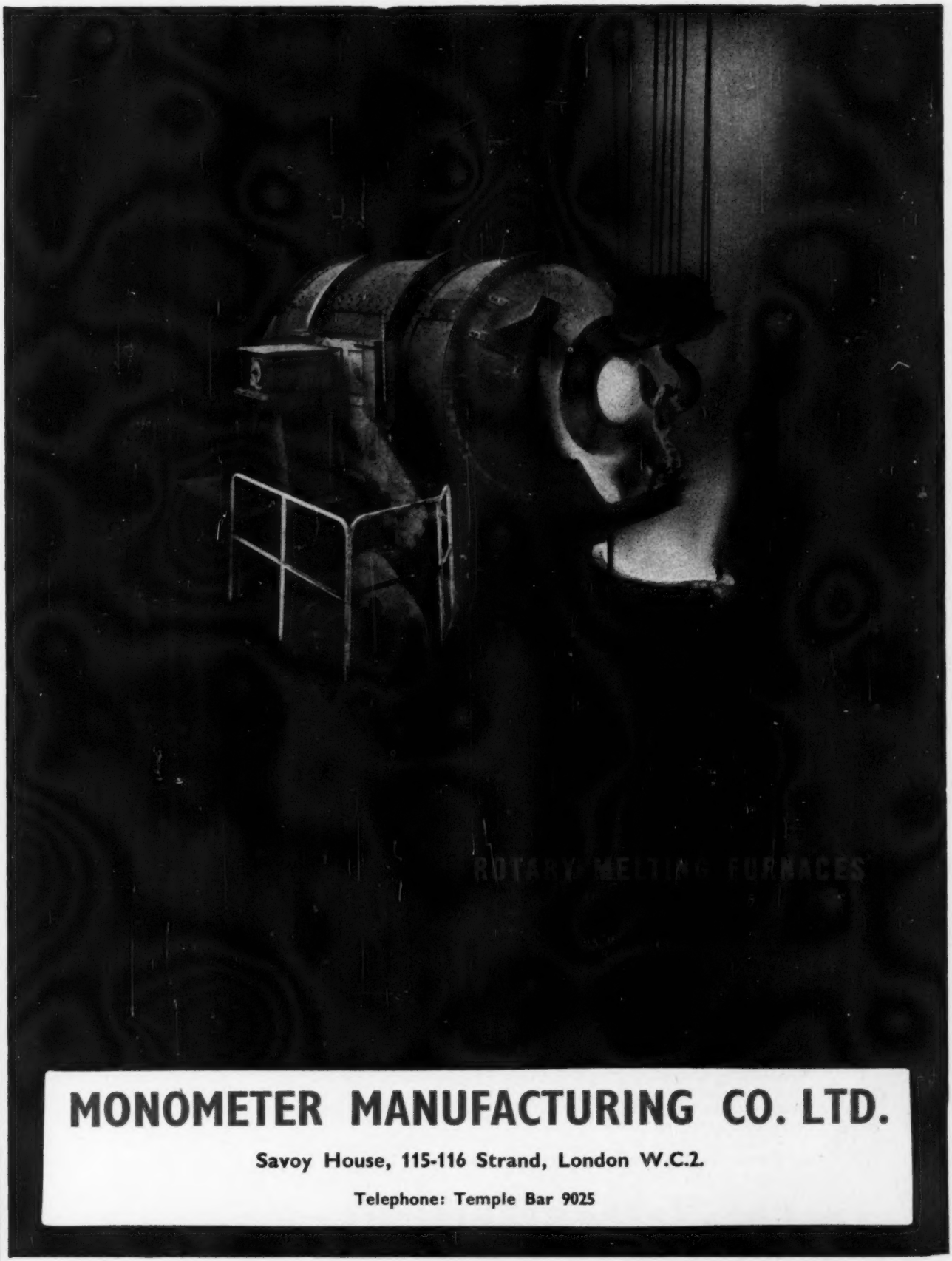

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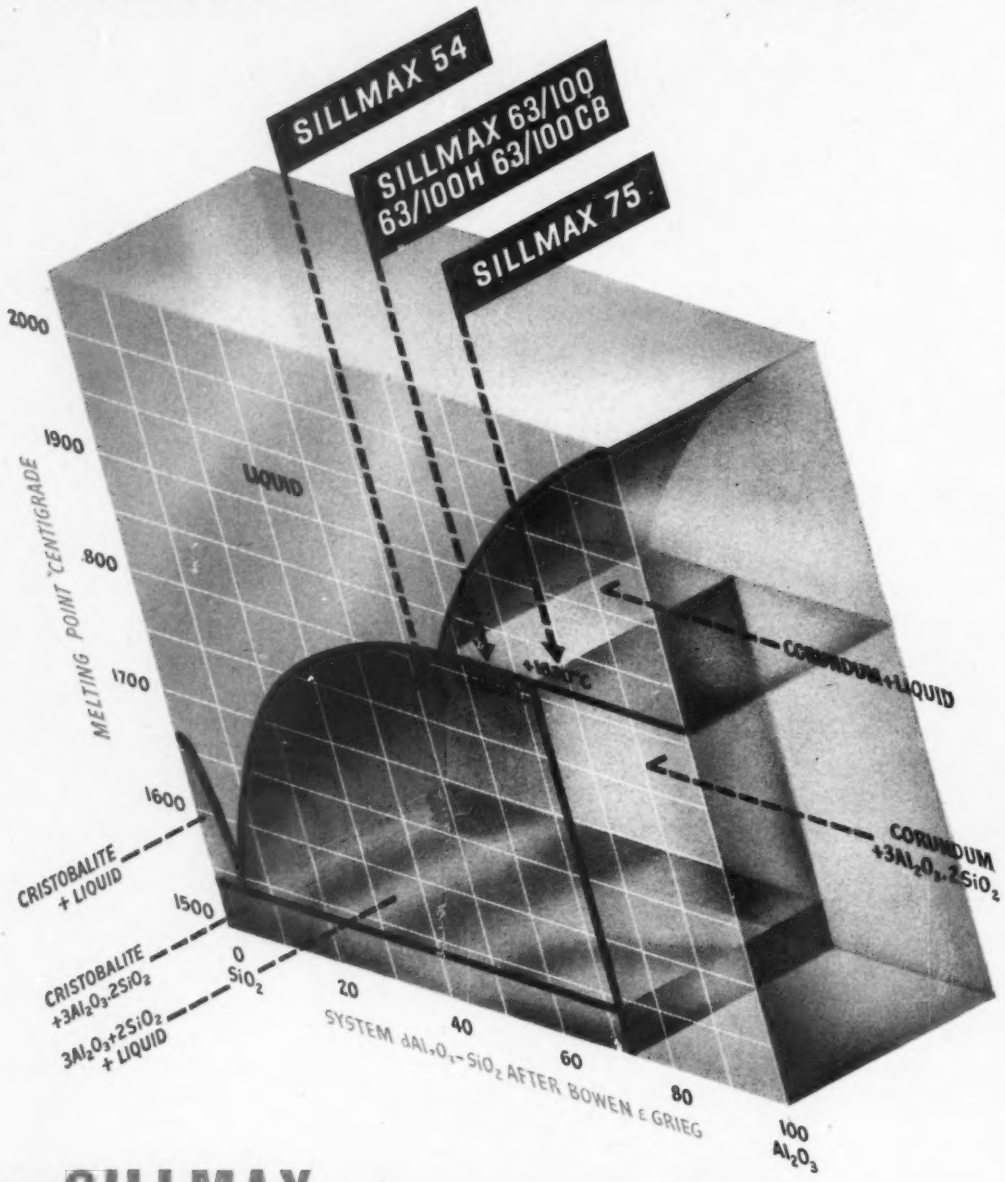

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METAL INDUSTRY

FOUNDED 1909

EDITOR: L. G. BERESFORD, B.Sc., F.I.M.

9 JANUARY 1959 VOLUME 94 NUMBER 2

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PUBLISHED EVERY FRIDAY BY ILIFFE & SONS LIMITED

Editorial Offices: 9 Charlotte Street, Birmingham 3. Telephone: Central 3206

Advertising and Publishing Offices: Dorset House, Stamford Street, London, S.E.1. Tel.: Waterloo 3333. Grams: "Metustry, Sedist, London"

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VOLUME 94 NUMBER 2 9 JANUARY 1959

The Tin Markets

AS far as the New Year is concerned, the outlook for the tin market so far has undergone little change. Permitted supplies from the six participating producing countries, if the first quarter's level of 20,000 tons (resulting from a 48 per cent rate of restriction) were to be continued throughout, will be down to 80,000 tons, while the output of smaller producers amounts to about 12,000 tons. Even if Russian supplies are not reduced and stay at about the 17,000 tons level, the resulting total of supplies for 1959 would be no more than 109,000 tons.

Commenting on the United States barter arrangements for tin metal, Vivian, Younger and Bond Ltd., the London brokers, say that the envisaged barter transactions, for delivery of the metal to the American stockpile, will not work directly to strengthen the market since the metal involved will be drawn from mine stocks. But any such barter deals will bring relief to the producing countries which are lucky enough to fix them up and they must help, indirectly, to mop up future supplies. Their effect must be, in short, mildly bullish. As regards the negotiations with the Soviet Union, these are thought principally to concern the placing of a limit on the level of Russian tin sales this year. Last year the sales amounted to at least 17,000 tons, and it remains to be seen whether the U.S.S.R. will consent to exporting a lesser amount.

Consumption in 1959 in the world, excluding the Soviet Bloc, may still be reckoned, conservatively, at 137,000 tons. This will include an estimate of 50,000 tons for the U.S.A., compared with 47,000 tons in 1958, 54,000 tons in 1957, and 60,500 tons in 1956. For all countries together, consumption may well be expected to keep up at the last year's rate of 87,000 tons, which is some three to four thousand tons less than the previous two years. On these figures, supplies would be in overall deficit this year by 28,000 tons and the balance of consumers' requirements, except in so far as they still have any room to work down their own stocks, would have to be met from Buffer Stock holdings, the total of which has been estimated in market circles at some 28,000 tons, comprising about 23,000 tons bought from the statutory contributions in the Agreement and the remainder with the Special Fund set up early last year. This Special Fund tin can be sold, in theory, at any time, at the discretion of the Buffer Stock manager, but the sale of the original 23,000 tons may only start when the cash price on the London Metal Exchange reaches £781 per ton. At the time of writing, prices are hovering round the middle £740 figure, and it may be that these lower prices simply reflect fears that the current surplus of metal on the market will be made heavier now that the current output quota period has begun. According to reports from Singapore, exports of tin from Malaya in December last were 57 per cent lower than in November. Exports during the whole of 1958 totalled 46,695 tons—the lowest for over ten years. On the overall supply-consumption outlook for the present year, it would seem reasonable to look for a gradually firming market. It should be recognized that, on price grounds, consumers may not feel much incentive to stock up, since the difference between present prices and the above-mentioned £781 a ton would be swallowed up by the cost of holding tin for about six months. But it should also not be overlooked that this latter price is only the permissive starting level for sales of the original 23,000 tons, and that all-out selling of the Buffer Stock holding becomes obligatory only when £880 a ton is reached.

Out of the MELTING POT

Twisted

THE metal leaving an extrusion die in the form of an extruded section can move in various ways. The usual way is, of course, movement in the direction of the extrusion die axis. It is not unknown, and generally undesirable, for the extruded metal to move in a direction or directions other than that of the die axis, thereby producing a bent or wavy extrusion. Another way in which the extruded metal could move would include movement in the direction of the die axis, combined with movement around this axis. This would result in straight but twisted or spiral extrusions. In the case of such extrusions, a rib or ribs on the surface would be spiralled, screw-thread fashion, round the central core of the extrusion. If the central core were made tubular, the use of such spiral extrusions for heat exchangers and the like readily comes to mind. A twisting movement of this kind can be imparted to the extrusion by using a die provided with grooves, ridges, or other forms of rifling, on the inside of the bore. In another more recently developed method, twisting of the extrusion is effected by inducing a couple or co-acting couples within the section during its extrusion, the couple or couples twisting the section about its longitudinal axis. Such a twisting force is induced by designing the entrance edge of the extrusion die to have a face lying in a plane tilted at a suitable angle to the plane normal to the axis through the die orifice. Thus, the entrance edge face may lie in a single helical curve of some pre-selected helix angle, the complement of which will be substantially equal to the angle of the helix or spiral produced in the section extruded through the die orifice. Alternatively, the entrance edge face may be arranged to consist of a number of inclined planes, all of which must be inclined in the same direction. The upper and lower ends of adjoining pairs of such planes are connected by steeply inclined, short (as viewed in plan) connecting planes, which thus form shoulders between the ends of such inclined planes.

The Other Way

CURRENT attitudes to research being what they are, the attention being given to ways and means of meeting the demand by research workers for information is readily understandable. The difficulties encountered in devising effective ways and means are well known, as is also the latest trend towards arranging that these difficulties should be dealt with, and, it is hoped, overcome, by mechanical and electronic equipment. This absorbing interest in ways and means of retrieving and supplying information has tended to detract from the interest in what is being supplied. The resulting unsatisfactory state of affairs, however, is in most cases likely to pass unnoticed because, of the two parties concerned, each usually sees only its own side of the situation. On the supplying side, a comprehensive search through the various sources of information, and presentation in a suitable form of the relevant information collected, is regarded with satisfaction. On the receiving side, this information gives rise to a feeling of gratitude (even though, as so often happens, the information is not exactly what was wanted or what had been expected), for obviously a great deal of effort has gone into its collection and presentation. This satisfaction on the one side and gratitude on the other, admirable sentiments though they be, would not survive a realistic appraisal. One of the conclusions of such an appraisal would undoubtedly be that research should arrange to rely less and less on a service which is still in the process of getting organized without any certainty of ultimate success. Instead, it should arrange to make more and more immediate use of information as and when it becomes available. To ask for something vaguely remembered as seen somewhere about eighteen months ago and then to be told that it cannot be "retrieved" or, if it is retrieved, to find that it does not meet one's requirements, reflects little credit on anybody. Using information on the spot, instead of trying to remember and find it after eighteen months, would mean that research would have to be much more flexible than it is at present, but would this be a disadvantage?

Inventive Departure

TRITELY enough, the inventive step required for success very often amounts to only a slight departure from the conventional. Such a departure enables success to be attained in a much simpler manner (one of the characteristics of an inventive step) than by adhering to the conventional and inventing something which is only new because of the complications required to permit the conventional to be retained. The above general statement is admirably illustrated by the strip rolling process. In the conventional process, the rolls are arranged one above the other, the solid metal stock passing between them from one side to the other in the familiar way, and being reduced in the process. The process can be adapted to the rolling of powdered metals by introducing such complications as a supporting strip and elaborate means for feeding and uniformly distributing the metal powder over the supporting strip. The inventive step that simplified the rolling of metal powders departed from the conventional and achieved success by placing the rolls side by side horizontally and introducing the powder from above. Similarly, attempts have been made to adapt the conventional arrangement for the purpose of producing strip from molten metal by introducing such complications as supporting mould strips or bands between which the metal is cast, etc. Departure from the conventional, consisting in arranging the rolls side by side horizontally and feeding in the metal from above dates back to Sir Henry Bessemer. They did not eliminate the difficulty arising from there being, as it were, too much molten feed metal to deal with satisfactorily. It seems that this difficulty may be overcome by the further slight deviation from the conventional represented by supplying the molten metal to the rolls from below. For this purpose, use is made of an open-ended slot nozzle, the upper end of which is shaped so as to conform to the surfaces of the rolls adjacent to the roll gap, and to form with them a chamber for the molten metal. The portions of the roll surfaces, forming at any given time part of this chamber, amount to no more than 5° to 15° of the circumference of the roll surfaces. The molten metal is fed upwards into this chamber under a pressure just sufficient to cause it to rise into contact with the roll surfaces on which it solidifies and on which, as the rolls rotate, it is carried into the roll gap in which the solidified metal is compressed, and from which it emerges as a strip.

Skimmer

SYMPOSIUM ORGANIZED BY POWDER METALLURGY JOINT GROUP

Ceramic-Metal Materials

UNDER the auspices of the Powder Metallurgy Joint Group of the Institute of Metals and the Iron and Steel Institute, a Symposium on "The Powder Metallurgy of Ceramic-Metal Materials" was held at Church House, Westminster, on December 16-17, 1958. The meeting began with an introductory Paper by **Dr. P. Murray** (Atomic Energy Research Establishment), and on the following day six Papers were presented and discussed in three groups, with two Papers in each group.

In the first group, the Papers were "Fabrication and Properties of Chromium-Alumina and Molybdenum-Chromium-Alumina Cermets," by J. B. Huffadine, L. Longland and N. C. Moore; and "The Fabrication and Properties of Uranium Oxide-Iron Cermets," by W. J. Wright, R. B. Gibbon and J. Williams.

FIRST GROUP DISCUSSION

Dr. R. Kiessling (Sweden) asked whether any experiments had been done by the authors of the second Paper with iron powders other than Swedish sponge iron? Was stainless-iron powder available, and were there any other heat-resistant powders tried?

Dr. Harrison (Sintered Products Ltd.) said they had found that flake iron powder lowered the extrusion pressure considerably. Had Wright, Gibbon and Williams tried it? The alteration of the included angle of the extrusion die could make a considerable difference both to the extrusion pressure used and to the quality of the billet extruded. Had the authors tried heating the die? A small increase in die temperature could have a marked effect on the extrusion pressure and on the ease with which the billet went through.

G. E. Darwin (Babcock and Wilcox) drew attention to a Paper by Cunningham and Beaver at the recent Geneva Conference, in which it was stated that a cermet of uranium dioxide with stainless steel had been used very successfully for the U.S. Army Package Power reactor. A burn-up of 40 per cent of all the uranium atoms was expected, as against about 1 per cent with the best uranium dioxide straight ceramic fuel. The use of stainless steel should be attractive, in that at the high heat-transfer rates required from a fuel element there would be with mild steel a considerable fouling factor, which would mean an excessive drop in temperature between the fuel and the water. As against this, mild steel had three advantages: it was cheap; its good thermal conductivity tended to reduce the temperature drop and offset the fouling factor; and it was relatively free from nickel and cobalt, both of which had caused considerable trouble in the Army Package Power reactor.

Wright, Gibbon and Williams mentioned that by tumbling the UO_2-iron powders for ½ hr. they could coat the UO_2 with iron. This was interesting, because in the carbide industry it was the practice to ball-mill (which was a much harder process than tumbling) for days on end to get the cobalt to coat the tungsten carbide.

Dr. T. H. Blakeley (Morgan Crucible Co. Ltd.), commenting on the view of Huffadine, Longland and Moore that there was no such thing as an ideal cermet, and that any cermet was essentially a compromise, said an example of this was the work on thermal expansion, where some compromise had to be accepted between getting a good match in the coefficient of expansion and some sacrifice of resistance to oxidation by the introduction of molybdenum.

He agreed with their view that the bond between chromium and alumina was not very strong, and this raised the question of the degree of mismatch in the coefficient of expansion between the metal and the metal oxide which could be tolerated in cermets of this type. Theoretically, it should be possible to calculate from a knowledge of the bond strength and the fundamental physical properties of the ceramic and the metal—properties such as strength, coefficient of expansion and elasticity—just what degree of mismatch could be tolerated. In their own experience a chromium content of 75-80 per cent usually gave the best compromise.

Some confirmation of ideas about cermets might be found from a very dissimilar field. The Road Research Laboratory had done a good deal of work on tar-aggregate mixtures, and found that if tar was added progressively to a mixture of stone materials, the strength, which to start with was very low, rose steeply and then fell off steeply, the maximum corresponding to the theoretical amount of tar required to fill the interstices.

Mr. Pennington (Haynes Stellite Co.) referred to the metal-ceramics of high metal-content, such as the LT1 type made by his company, which were mentioned in the Paper by Huffadine, Longland and Moore, and said that the authors appeared to consider that none of the materials which they reviewed had a sufficiently good combination of properties for aircraft gas turbine blading. That was also the view of his company in the U.S.A., their brittleness being the main factor in limiting their use in this field.

There were, however, many other fields in which they could be used. In addition to the uses mentioned by the authors, these cermets had been employed where there was chemical attack, the LT1 being used in hot gas streams containing SO_2 and SO_3, and where hydrogen chloride or concentrated sulphuric acid was present, and in sulphur-bearing furnace charges. The LT1B chromium-molybdenum-alumina material was used in furnaces and boilers handling crude fuel and fuel oils with ash residues, and had much better resistance to shock than the straight alumina-chromium cermets.

A new development by his company was the tungsten-base cermet (60 per cent tungsten, 25 per cent chromium, 15 per cent alumina) called LT2. This had higher bonding strength and higher hardness than the LT1 and LT1B materials, and had been used with success for rocket nozzles where considerable erosion occurred. They were now working on new slip-cast materials based on tungsten, and had produced pieces up to 100 lb. These pieces were used where high-temperature shock and erosion were taking place.

D. A. Oliver (B.S.A. Group Research Centre), discussing the role of chromic oxide in alumina-chromium cermets, said that, due to the method of hot pressing using graphite electrodes, carbon monoxide was generated which reacted with the chromium to produce chromium carbide and chromic oxide. He felt that the chromium carbide was undesirable, but that chromic oxide might be helpful. Huffadine, Longland and Moore showed that the chromium particles did not appear to wet the alumina, and this was aggravated by the difference in expansion coefficients, but it was possible to match the metal phase to the alumina phase. If an oxide was present at the beginning of sintering, chromic oxide would diffuse and be very adherent to the chromium. If there was not too much of it, this might go a long way towards making a stronger bond between the chromium and the alumina, in which it is also soluble. He was not convinced that the use of very pure chromium would give greater ductility. The chromium had to be extraordinarily pure before it showed abnormally increased ductility, and, in any case, even traces of oxygen would remove a great deal of its enhanced properties.

Dr. J. S. Jackson (British Thomson-Houston Co. Ltd.), dealing with the same Paper, expressed surprise that the temperature for sintering the chromium-alumina system was almost identical with that for hot pressing. In most systems one would expect the

hot-pressing temperature to be appreciably lower. It was the more remarkable because alumina hot-pressed relatively easily compared with the carbides, borides, and so on. Was the answer that it was not the alumina so much as the chromium which was governing the sintering and hot-pressing characteristics?

Dr. Peter Murray (A.E.R.E., Harwell) asked how the properties of the chromium-alumina cermets compared with those of the base material, sintered alumina. For example, the modulus of rupture of sintered crystals of alumina was in the region of 40,000 lb/in^2 or more. There were now available many sintered polycrystalline aluminas with bend strength values in this region, and it had been suggested that by further attention to the grain size in the sintered alumina, strengths 50-100 per cent higher than this could be obtained. It would be of particular interest to know, therefore, how the thermal shock properties and strength properties of the chromium-alumina bodies were related to those of the base material.

N. B. Rutherford (Thomas Bolton and Sons Ltd.) remarked that there was a tendency in discussing the metal-ceramics to think in terms of the more exotic applications, such as gas turbines and atomic energy, but there were others of more interest to many people. His firm undertook the continuous casting of phosphor bronzes and used a thermocouple to measure the temperature of the metal before it passed through the die. To protect the thermocouple from attack they had used some chromium-alumina sheaths supplied by the Morgan Crucible Company, and the first results had been very promising. They operated at temperatures of 1,150°-1,200°C., and the plant ran continuously five days a week. Two sheaths were used, 8 in. long, $\frac{5}{8}$ in. o.d., and with a wall thickness of $\frac{1}{4}$ in., with a small collar $\frac{1}{2}$ in. wide at the top. After 4-5 weeks, neither had suffered any marked attack, but both then failed by cracking between the collar and the sheath, presumably due to thermal fatigue, although the cracks might have been there from the forming of the collar.

The copper-alloy manufacturer was also interested in the application of cermets for extrusion dies, but there did not seem much hope there, because of the poor resistance of these materials to thermal and mechanical shock, and thermal fatigue.

J. Williams, replying, said that stainless steel powder had been used; it behaved much as the mild steel powders did, but could be used at slightly higher temperatures, and would be of advantage where a gas coolant was used. Corrosion resistance had also to be borne in mind. In using the cermet type of fuel element as a high-temperature fuel, the high-temperature strength of the matrix material would be a limiting factor, and here again stainless steel would be better than mild steel. They had not used flake iron powder and UO_2, but when using flake aluminium powder and UO_2 they found great difficulties with the segregation of the UO_2 in the matrix; it was difficult to disperse it uniformly and there was a tendency to accentuate stringing. The Americans used the UO_2-stainless steel cermet in their Package Power reactor, and he had seen figures for burn-up quoted as high as 80 per cent of the uranium without undue dimensional changes, but with this reactor the cost of power was secondary. It was doubtful whether the power obtained from this type of reactor would ever be competitive commercially.

J. B. Huffadine, replying to the question of what degree of mismatching in thermal expansion coefficients could be tolerated, said his answer would be the maximum possible without breaking the bond between metal and ceramic. In a low-metal cermet where the metal particles were discrete, if the expansion coefficient of the metal was greater than that of the ceramic the metal would be in tension and the ceramic in compression, giving the equivalent to a prestressed-concrete structure which would be much more resistant to impact and have a higher room-temperature strength. With higher metal content, the reverse was the case, and one wanted the outer skin to be in compression. This would affect only the low-temperature properties, but for some applications it might result in a major improvement.

They used Pennington's cermets in chemical plant, and they were extremely resistant to all the more common solvents. The authors agreed with Oliver that chromic oxide dissolved in alumina and adhered remarkably well to chromium, but there was no evidence that a comparatively dilute solid solution of chromic oxide in alumina would adhere better to chromium.

Dr. Jackson said that alumina hot-pressed comparatively easily, but, in fact, this was very dependent on the purity. Hot-pressing of the 99·999 per cent alumina was nothing like so easy as with the usual 99·9 per cent material, so that impurity content might well come into the matter. It was possible that the chromium was the material which flowed, rather than the alumina. The melting point of chromium was lowered very rapidly by the addition of a small amount of carbon. They tried to keep carbon out, but a small amount got in, and this meant increased mobility of the chromium ions, so that it was likely that chromium played a large part in the densification of these materials.

Dr. Murray asked how the properties of the cermets compared with those of alumina. The low-metal cermets were not very much better than a high-grade alumina. The thermal shock resistance of 20 per cent chromium-aluminium material might or might not be slightly better than that of alumina, depending on the quality of the alumina against which the comparison was made.

This led to the question of how cermets with sintered alumina having various alumina contents compared with regard to applications. For some applications, such as tool-tips for machining, and where there was friction of metal over the material, the higher the ceramic content the better, but where some shock-resistance was required cermets of comparatively high metal content were preferable. So far as he knew, the application to extrusion dies had not been tried. It raised the question of what sort of extrusion die was wanted. Was erosion by the metal important? Was the die to be used cold, perhaps in a tube-drawing application? In that case a high alumina cermet might be useful; but for standing up to great impact or severe thermal shock, perhaps anything with a ceramic in it was better avoided.

SECOND GROUP

The second group of Papers discussed included "Recent Developments in the Field of the Borides and Silicides of High-Melting-Point Transition Metals," by R. Kieffer and F. Benesovsky, and "Bonding in Carbides, Silicides and Borides," by D. A. Robins.

THIRD GROUP DISCUSSION

The third group of Papers to be discussed was:—"The Oxidation of Zirconium Carbide in the High-Temperature Combustion Gases," by W. Watt; and "The High-Temperature Properties of Ceramics and Cermets," by E. Glenny and T. A. Taylor, and a report of the discussion on this group follows.

Dr. C. E. Ransley (British Aluminium Company Limited) said that they were interested in pure uncemented carbides and borides, and had accumulated a good deal of information which had so far gone unpublished. They had obtained data on the oxidation characteristics of titanium carbide and titanium boride at temperatures up to 1,000°C., their tests being carried out on samples of hot-pressed titanium carbide and boride of fairly high purity and densities higher than 90 per cent theoretical, subjected to oxidation for periods up to 200 hr. in normal moist air.

The oxidation process in both materials was far from homogeneous. The curve for titanium carbide showed a marked peak at 450°C. which had not been reported before, other workers having started their tests at higher temperatures. Oxidation at 450°C. was particularly disruptive, because it proceeded linearly, with no protective formation at all, "so that given time," he said, "we end up with a heap of powder, which can be very embarrassing in certain applications."

At 500°C. there was evidence of protective film formation. At 600°-700°C. the oxidation was parabolic, with a permanent protective oxide being formed, while above 700°C. a very adhesive yellow oxide was formed, which was the high-temperature form of titanium dioxide and very dense. It tended, however, to become partially detached from the titanium chloride when the sample was cooled down to room temperature. In the high temperature range the controlling factor was diffusion through the oxide film. For the carbon, this must involve diffusion from the titanium carbide surface to the outside, as otherwise gas generation would lead to continuous disruption of the oxide.

The oxidation of titanium boride was considerably less than that of titanium carbide. There was a similar but smaller peak at 450°C., and a thin protective film was present around 600°C. The oxidation product was very adherent and fairly glassy over the whole temperature range.

Mr. Seebohm (Oxford University) dealt with the technique of hardening metals by internal oxidation. A refractory oxide was precipitated as a dispersion of fine particles of about 100Å apart, by diffusing oxygen into a dilute solid solution of a metal with a high affinity for oxygen in a matrix metal which was more noble (e.g. alumina and beryllia in copper or nickel). The dispersions were thermally stable at all temperatures below that of their formation, which could be close to the melting point. Massive solid alloys took a long time to treat in this way if oxygen had to diffuse from the surface, but experiments had been started at Oxford on powder alloys in which each powder particle had a surface oxide scale which acted as a source of oxygen to enable internal oxidation to take place during the usual sintering treatment. Experiments with 0·38 per cent beryllium in copper, sintered for 2 hr. at various temperatures in argon, showed a rise in the yield point and a maximum hardness of 125 Vickers, while the unhardened alloy was within the range of pure copper, 31-43. The comparatively small improvement in the yield-point of 1 per cent aluminium in nickel seemed to be the result of oxidation taking place only in about half the volume of each powder granule, but microhardness measurements showed that the ozidized areas had almost double the hardness of the unoxidized parts.

D. A. Oliver (B.S.A. Group Research Centre) pictured these cermets as being somewhat porous but subject to intense tesselated stresses internally. There were little junctions and bridges in the material which were just about to rupture, and others in intense compression. He imagined that in these ceramic materials, where the chemical bonds predominated over the ionic bonds and the chemical forces were highly directional, there was a much more intensified stress state of affairs than in an ordinary metal, or metal system. When retained austenite transformed to martensite in steel, there were intense local stresses and microcracking in the martensite, and this seemed to be a comparable case.

This raised the question of whether or not these cermets should be subjected to heat-treatment. Possibly by adding or removing oxygen the internal stresses could be reduced. When fusing or sintering alumina materials, small quantities of glass were formed by the impurities present, and the rate of cooling from a high temperature determined the subsequent brittleness or toughness of the sinter. The sinter was not very sensitive to cooling below 1,000°C., but might be very sensitive between 1,300° and 1,100°C. That idea should be injected into the whole subject of cermets, because these impurity glass phases might be leading to poorer performance.

If the internal stresses were very high, the cermet would be highly susceptible to major cracking on the first application of heat. This suggested that cermets might be protected by sprayed sacrificial coatings. There had been great advances in sprayed metal coatings, and newer alloys were coming along which should give good temperature resistance up to 1,250°C. Even if they oxidized and wore out, they should last long enough to protect the cermet from premature damage.

D. E. Worn (Mond Nickel Company Ltd.) raised the general question of the fatigue failure of some of the metal-ceramic combinations. These materials offered valuable properties but had very low impact resistance. Presumably, crack propagation would be through the metal matrix or the metal/oxide interface, or through the oxide or carbide particles. There was evidence that with some of the cemented carbides it was the carbide particles which failed.

The Mond Nickel Company had done work on iron-magnesia cermets, where one of the problems was the strength of the metal/oxide interface, and had demonstrated the importance of excess oxygen. Material containing up to 20 per cent (by volume) magnesia was extremely brittle if sintered in hydrogen, but if they sintered it in nitrogen and allowed about 0·1 per cent, or even 0·05 per cent, oxygen in the iron constituent they obtained a product which could be readily forged and which had remarkable ductility. He wondered whether or not the particle size of the oxide phase in the finished product had any influence. Very fine oxides might be expected to inhibit crack progression owing to the higher energy required to initiate cracks through the successive oxide particles.

J. W. Hains (Rolls-Royce Ltd.) said that they were very interested in the effect of thermal cycling, which was most important for civil applications in engines, where the engine had to make a very large number of starts. In the case of molybdenum disilicide, for which great hopes had been held out, they could support the results of Glenny and Taylor; they could heat it very rapidly to 1,150°C. without trouble, but as soon as the fuel was turned off, the test-piece (in the form of a blade) broke into pieces. The major limitation with these materials had been that the rate of crack propagation was much greater than in the conventional metallic materials used for blades. He was interested in Mr. Oliver's suggestion of a protective spray coating, but with the types of spray coating which they had tried they found that the differential expansion caused spalling.

Dr. P. Murray (A.E.R.E., Harwell) said that Glenny and Taylor had conclusively demonstrated that thermal expansion was the most important factor in severe thermal-shock conditions. Had they considered using fused silica (which seemed to be the best material) as the matrix or main material in a composite body, making additions of other refractory particles to overcome the low creep resistance of fused silica under high stresses at high temperatures? Worn had asked about the effect of particle size or grain size on the strength of some of these materials. So far as the pure oxides were concerned there was, for example, with some of the aluminas and beryllias a marked effect of grain size on the room temperature bend strength.

J. B. Huffadine (Plessey Company Ltd.), replying to Oliver's question about the effect of thermal treatment on the strength of certain materials, said they had frequently noticed that following an oxidation test at 1,200°C., the room-temperature modulus of rupture in chromium-alumina was increased. With molybdenum-chromium-alumina they had not noticed it so much. This applied only to the room-temperature figure; the high-temperature strength was unaffected. Prolonged annealing at 1,200°C. might permit a certain amount of stress relaxation.

Dr. T. H. Blakeley (Morgan Crucible Co. Ltd.) agreed with Glenny and Taylor that low impact strength was probably the chief drawback of the newer materials for high temperature and difficult conditions, and asked whether or not these authors had found any correlation between impact strength and thermal shock resistance, possibly coupled in the latter case with the coefficient of expansion. If designers and the people who were developing the new materials could get together, and if the designers could be persuaded to design to suit the properties of the materials, instead of asking for materials to suit almost impossible conditions, more rapid progress could be made. They themselves had been able to achieve something on

these lines, where the design of a blade in an experimental gas turbine had been altered in shape and method of holding so as to minimize the weak points of the material.

R. F. Smart (Tin Research Institute) pointed out that while chemical wetting was desirable in cermets it was not very often achieved, and the only alternative was the use of brute force to try to force the metal round the ceramic to make what was called a mechanical bond, and it seemed to be inferred that this was almost as satisfactory as a chemical bond. The Tin Research Institute had carried out experiments on the properties of extruded fine tin powder containing fine dispersions of alumina and carborundum powder. The extrusion was carried out at room temperature, which for tin was almost equivalent to hot extrusion with the high-melting-point metals usually employed in cermets. Extruded tin powder without any addition had a tensile strength of about 3½ tons/in² and a ductility of about 30 per cent. It became no stronger by the addition of alumina; the only effect was a marked, and in some cases catastrophic, decrease in ductility, which they ascribed to the non-wetting of the alumina by the tin. In view of those results, he doubted the efficacy of the so-called mechanical bond.

Dr. P. Murray, replying to this point, said he did not feel that a mechanically-bonded cermet was as good as a chemically-bonded cermet. The point about oxide cermets compared with carbide cermets was that so far, in chromium-alumina and other compositions, they had not been able to enhance the strength of the composite body very much, and were still at about the same value as for the ceramic material, whereas in bonded carbides there was a factor of about 3 difference between the strength of tungsten carbide bonded with 6 per cent cobalt and tungsten carbide alone.

E. Glenny (National Gas Turbine Establishment), replying, said the results of their work from the user aspect had been a little depressing so far. They had started off in their tests with the object of separating the wheat from the chaff, but, so far as gas turbine blading and properties such as thermal shock and impact resistance were concerned, they had simply managed to separate the chaff from the straw. They had not yet investigated the effect of subjecting cermets to heat-treatment, and the only evidence they had that heat-treatment might be beneficial was that in some creep tests they had used a stepwise test to establish the strength, and the final result, ending with a stress of 14 tons/in², gave a life of 100 hr. On a non-stepwise test, failure usually took place at a lower stress, which indicated that prior heat-treatment (associated with prior stressing in this case) conditioned the material in such a way as to improve its strength.

Sprayed coatings might be useful. In the U.S.A. it had been found possible to get a five-fold improvement in impact by a creep-resistant metallic coating on the cermet, possibly 0·02 in. thick.

In reply to the question of the forms of failure by impact or thermal shock in cermet material, the crack produced followed nearly straight-line propagation, and was not choosy about going through the metal phase or the ceramic phase. It was essentially a transgranular crack. They had not found any correlation between impact strength and thermal shock resistance, though up to a point some might be expected, since in both cases the stress was applied very quickly, and a material of negligible ductility had not time to yield, so that there was rapid propagation of cracks.

He sympathized with Dr. Blakeley's comments on how designers could help. Where blading was concerned there were two things which could be done. One was to make the blades hollow, and the other to make the leading and trailing edge radii as large as possible, though the aerodynamicists would have objections to this.

T. A. Taylor (National Gas Turbine Establishment), while agreeing with Dr. Murray that chemical bonding offered better prospects of obtaining high-strength materials, suggested that there might be one or two exceptions to this. If it was possible to arrange that both components formed continuous structures, as distinct from a random distribution of one in the matrix of the other, the chemical bonding of the two might be less important, and a weak bond might even be advantageous by assisting in preventing crack propagation.

Standardization

TO secure identical values for the yard and the pound in precise measurements for science and technology, it has been agreed by Commonwealth and United States standard laboratories to adopt an international yard and an international pound having the following definitions:—the international yard equals 0·9144 metre; the international pound equals 0·45359237 kilogramme.

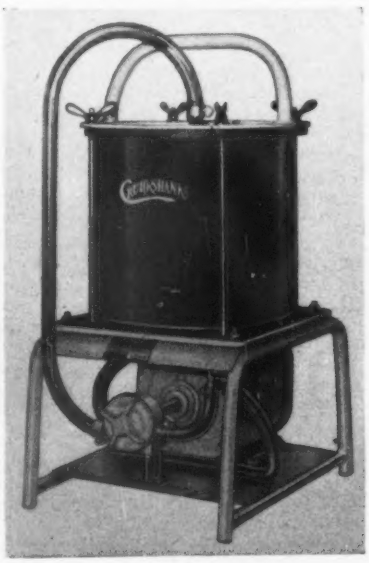
It has also been agreed that, unless otherwise required, all non-metric calibrations carried out by these laboratories for science and technology on and after July 1, 1959, will be made in terms of the international units as defined above or their multiples or submultiples.

The Board of Trade point out that the units will have no statutory force in the United Kingdom, and may not be used for trade purposes in this country. The yard and pound units to be used in trade are the imperial units laid down in the Weights and Measures Act, 1878.

The adoption of the international values of the yard and the pound will be of particular benefit to all those concerned with accurate measurements of length and mass for scientific and technological purposes in the British Commonwealth and the United States.

Lightweight Plating Filter

A LIGHTWEIGHT plating filter, weighing only 40 lb., has been introduced by R. Cruickshank Ltd., of Camden Street, Birmingham. This unit, the 301.S, is self priming, has an output of 250 gal/hr., and takes under 2 ft² of floor area. It can be used for all types of plating solutions up to 150°F., excepting chromium solution and strong acids.



The unit is compact and simple, yet strong due to its special construction, and can be completely dismantled, including the pump unit, in under 3 min.

The self-priming pump is of corrosion-resistant plastics, with a Neoprene impeller mounted on a stainless steel shaft, and all parts are replaceable. There are no glands or stuffing boxes, the bearings being constructed of carbon graphite.

The filter body is of rigid P.V.C. containing a filter of approximately 5 ft² of filtering area.

Piping is of polythene, and there are no valves to operate. The unit incorporates a special safety return feed from the filter to the pump, which ensures that the pump is always primed and that there is no danger of excessive pressure being produced in the filter body.

Finishing Supplement

Ultrasonic Plating

ADVANTAGES OF HIGH-FREQUENCY BATH AGITATION

ULTRASONICS are being used in connection with both electrical and electroless plating operations at Fairfax Aircraft Co., Los Angeles, Calif., and where electroless work is done, they have the principal advantage of improving both the plating rate and the lustre of metal finishes.

Apart from the fact that ultrasonically-agitated baths are used, the plating methods employed are conventional.

Frequencies used for the subject work are in the range of 16,000 to 30,000 cycles/sec., due mainly to a lack of transducers for the generation of higher frequencies with proper wavelengths and intensities.

Transducers specifically suitable for industrial plating are those of the stacked-nickel type. In such a transducer, electronic energy is converted into powerful mechanical vibrations when nickel laminae are expanded and contracted by an alternating electromagnetic field.

When dispersed in a plating solution, the ultrasonic output of a stacked-nickel transducer has the basic advantage of long wavelength. Among other things, this phenomenon permits an increase in the "throwing power" of an electrolyte so that holes and other recesses can be plated satisfactorily.

Also important are cavitational effects, due to alternating pressures which occur when ultrasonic vibrations are used to agitate a solution. Because of these effects, intense "scrubbing action" is attained and unwanted gases are expelled from an electrolyte.

In electroplating, stagnant layers of electrolyte in the vicinity of electrodes have long been a recurring maintenance problem because they can retard and even halt production work. Experience in barrel plating long ago proved that mechanical agitation can prevent the formation of such layers, but, unfortunately, conventional agitators could not be used with good results where tank plating had to be done.

Plating Equipment

No important change need be made in a plating set-up in order to utilize ultrasonic agitation, since an appropriate transducer is relatively small, may be located in many convenient positions on or near the bottom of a plating tank, and can be powered via coaxial cable with electronic equipment some distance away from the actual work area.

As a rule, the electronic generator must provide a transducer with 400 or more watts of power—depending, of course, on the size of the plating tank—in order to be effective.

Cadmium, Copper and Silver

The effectiveness of ultrasonic agitation in electroplating was initially demonstrated in work with a more or less conventional cadmium cyanide bath. Standard 1 in. by 4 in. steel strip specimens were pickled and cleaned in the usual manner, and then masked so that 1 in^2 areas could be finished—with and without agitation. Then plating was done at a current density of 250 amp/ft^2.

A typically "burned" coating was produced on each specimen that was plated in an un-agitated solution, while a bright cadmium finish was obtained on each strip that was plated in a bath activated by ultrasound at 20 kc/s.

Subsequent experiments disclosed that excellent cadmium plating could be obtained with the latter agitation where current densities up to 750 amp/ft^2 were employed. This, of course, established the fact that throwing power and the rate of plating (to about 0·6 mil of cadmium per 3 min. of processing time) could be greatly increased by permitting the effective use of very high current densities.

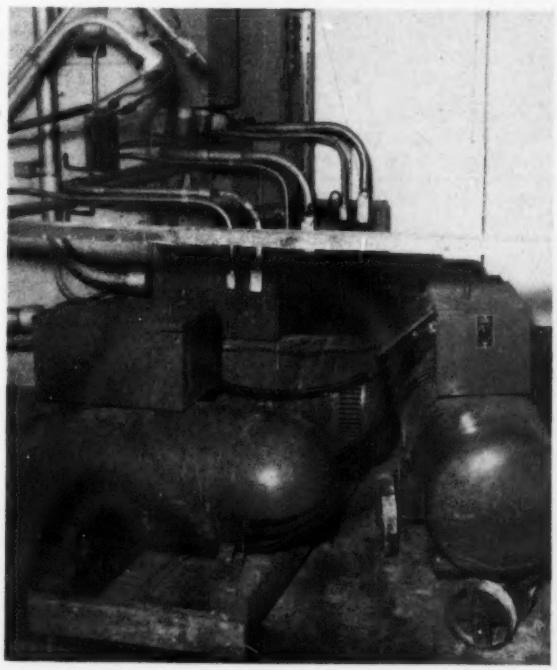
At present good cadmium plating is being produced on, and in, parts with threaded holes more than 1 in. deep. In addition, it has been shown that corroded and greasy parts can be plated without preliminary cleaning, due to the scrubbing action which they receive as soon as they are immersed in an ultrasonically-agitated electrolyte.

There is obviously little or no point in contaminating a plating solution by using it to process parts that are consistently unclean. However, the cleaning ability of a solution agitated in this way is important to the extent that it minimizes rejects where parts have not been thoroughly decontaminated during degreasing and pickling operations.

It is further possible that some cleaning operations can be eliminated in electroplating shops if continuous filtration systems are used to remove contaminants from ultrasonic baths.

For the electrodeposition of copper and most other metals, ultrasonic agitation has substantially the same advantages as in cadmium plating.

Where high current densities have



Equipment used for conversion of alternating current to high-frequency power for ultrasonic transducer used to agitate plating bath

been used to accelerate silver plating in agitated solutions, somewhat frosty coatings have been obtained. But the electrodeposited metal was tightly bonded and could not be scratched or abraded away, even where plating rates were 15 times normal.

Chrome and Nickel

In the agitation of solutions for hard chrome plating, ultrasonics have manifested all the advantages associated with its use in cadmium plating plus unprecedented ability to minimize material build-ups on the edges and corners of parts.

Electroless nickel plating baths, heated to 95°C., will deposit about 0·2 mil of nickel on metal parts in about 45 to 55 min. But when vibrated at 20 kc/s, the same baths will build up 1·0 mil coatings in periods averaging 15 min.

Since finishes deposited by ultrasonically-vibrated electroless solutions have exceptional brightness and lustre, it is apparent that plating speed in the latter instances is mainly the result of cavitational effects which allow superior wetting action.

Titanium-Platinum Anodes

TITANIUM, though virtually immune to corrosion in brine, is not a suitable anode material because the protective oxide film which forms on its surface resists the passage of an electric current. Attempts to force a passage by using high voltages may result in failure of the film and severe local corrosion. Research has shown, however, that this high resistivity is very much reduced when titanium is brought into electrical contact with a second metal. In particular, contact with platinum, deposited on the titanium either in strip or wire form or as a thin film, produces a very effective electrode system.

Most of the current is carried by the platinum, while the proportion carried by the titanium is sufficient to effect the anodic polarization of this metal and to ensure continuous maintenance of the oxide film. This phenomenon persists even if the titanium is exposed to the electrolyte by discontinuities in the platinum film, and at current densities of more than 500 amp/ft^2.

This development makes available an anode material as efficient as platinum at much lower cost.

Because it is not subject to metal loss, platinized titanium may offer useful advantages over other non-consumable anode materials in cathodic descaling equipment for cleaning wrought stainless steel in acid media, and in the electro-galvanizing of carbon steel wire in sulphuric acid/zinc sulphate electrolyte.

Another promising outlet for platinized titanium as a much cheaper substitute for wrought platinum is as anodes in rhodium plating baths. Experience has shown that, with the composite anode, while there is less evidence of gassing on the cathode surface, gas evolution at the anode occurs more readily. As a result, rhodium plating operations are carried out more efficiently and throwing power appears to be improved.

One specific field of application is that of electrolytic cells used in the chemical industry for the manufacture of caustic soda and chlorine from brine. The cathodic protection of marine structures is another. In this latter case, the advent of platinized titanium electrodes means that, for the first time, an anode material ideal for the purpose is available. Light in weight, strong and exceptionally corrosion-resistant, these bi-metallic anodes will operate satisfactorily at current densities far higher than the maximum 15 amp/ft^2 possible with more conventional materials. Much smaller anodes can, therefore, be used.

Water purification by electro-dialysis, and the production of sodium hypochlorite for sterilization are two further uses for platinized titanium electrodes.

When graphite is used in the electrolytic processing of sea water or brine to produce sodium hypochlorite for sterilization purposes, surface disintegration makes necessary periodical machining of the electrodes and consequent adjustment of the gap between them.

Platinized titanium electrodes require no such treatment and the gap remains constant. As with electro-dialysis plant, platinized titanium can be used for both anodes and cathodes provided that the current is reversed at regular intervals to remove cathodically-deposited salts. Trials indicate that in these conditions a greater concentration of chlorine can be achieved at a higher electrical efficiency and with a saving of as much as 50 per cent in salt electrolyte. In addition, much smaller units can be designed by utilizing titanium electrodes.

Having all the characteristics of platinum but without its cost disadvantages, platinized titanium opens up new possibilities for the employment of electro-phoretic techniques for the separation of colloids on an industrial scale, at present used only on a laboratory scale because the platinum wire electrodes needed for this process are so costly.

Bright Electrodeposits

BRIGHTNESS of an electrodeposited coating is dependent upon the high reflectivity of the surface crystallites, and the finer these crystals are, the more brilliant is the surface appearance. The crystal structure of an electrodeposit is itself dependent upon a number of conditions in the plating bath. Among these conditions are the concentration at which the solution is worked, the current density employed, and the nature of the anions in the bath when deposits are being made from metallic salts.

Hydrogen is disengaged at the cathode and can cause porosity in the deposit, or may even give rise to excessive non-adherence. Other dominant factors in the formation of the crystal structure of the coating are temperature rise, bath agitation, and speed of deposition.

To obtain a bright deposit, all those factors that favour crystal growth must be eliminated. According to an article in *Metallwarenindustrie und Galvanotechnik*, the steps which should be taken to promote brightness are:—working to obtain the maximum deposit in the minimum time, increasing the bath concentration and the current density (proportionately), choosing salts with complex anions for the solution formulation, using bath agitation, periodic reversal of current, and heating the bath.

Impurities in the bath have a disturbing influence, whether they are mineral or organic. However, in certain baths organic compounds in colloidal solution are added to favour the fineness of the crystalline grain of the deposit. These additions should be of very small amounts to avoid any risk of non-adhesion of the deposit.

The treatment subsequent to the plating can likewise exercise an influence on the structure of the deposit. Mechanical treatments (grinding, polishing, etc.) act on the crystals by rounding off sharp corners and, moreover, the local heat produced during these treatments can serve to act as thermal treatments. Thermal treatments are favourable to the formation of fine crystals. In addition, diffusion phenomena need to be taken into consideration, which can lead up to the formation of an alloy between the deposit and the base metal, which will serve to improve the adherence.

Design of Die-Castings

IX—Converting Sand-Cast Parts to Die-Casting

By H. K. BARTON

(*Concluded from* METAL INDUSTRY, 2 *January*, 1959)

EVEN where due attention is paid to requirements of the die-casting process, the thinning-down of walls, and so on, there is often a tendency to regard the external contours of the past as sacrosanct, so that all the modifications are made on the inside of the component. It is this, for example, that makes necessary the bosses, quills and rivets of Fig. 7. As will be obvious, an alternative to all these is to displace the surface of the casting inward (either by locally recessing it or by a general modification of the contours) and to mount the mating part directly upon the displaced face, as in Fig. 8. This is not a course that would normally be adopted in the case of a sand-casting, since it would entail facing off the whole area of contact. The planarity of a die-cast surface is, by contrast, adequate for anything short of an airtight joint between the parts.

Thus, it is seldom necessary for any practical purpose to provide raised machining pads on die-cast components, and where these occur it can often be guessed that they are fossilized features carried forward unchanged from a sand-cast (or, occasionally, gravity-cast) original. Where, for some reason, clearance is required beneath a sub-assembly, however, there are various ways of achieving this without any substantial alteration of wall thickness. Small auxiliary parts can be satisfactorily located within a peripheral rib, buttressed as in Fig. 9, the part being retained by local staking of the edge of the rib at three or four places.

If the subsidiary part is of circular profile it may be desirable to form it with a notch at some point on the edge in order to assure correct angular location. The rib is then provided with a corresponding projection. It is, of course, not always necessary to utilize an unbroken rib entirely embracing the sub-assembly, for in some cases short lengths of rib or isolated buttresses (*a*) will suffice. It is usually found most satisfactory to locate ribs near a corner but not, as a rule, to carry them round it, since all convergences of three planes—i.e. boxlike corners—can result in local overheating of the die.

One not infrequently comes across applications where a sealed sheet metal sub-assembly having an irregular surface is mounted within a die-cast housing, more or less as in Fig. 10, which shows only their relative positions. The position shown is primarily dictated by the need to assure a few thousandths of an inch clearance at *x*, in order to prevent distortion at assembly. The sub-assembly can be mounted by any of the means already described and depicted in Figs. 4 to 6, and the method likely to be adopted by most designers is probably one of those embodying simple spacing pillars rising (as, for example, in Fig. 4a) from a flat, unbroken surface.

This is no more than saying that the sub-assembly is entirely contained by the housing, and this might seem to be a self-evident requirement, but in point of fact there is often no functional objection to the partial closure of the housing by the sub-assembly itself. The method is illustrated in Fig. 11, where it will be seen that an opening more or less correspondent to the periphery of the sub-assembly is left in the die-casting. This opening is surrounded by a re-entrant shelf or rib, provided with location faces such as the lug *L*, by means of which the sub-assembly is secured in position.

The irregular contours of the sub-assembly are here accommodated in the space thus formed, but are, of course, exposed at the rear of the housing. However, since it is only envisaged that this method will be adopted in applications where the housing is itself permanently attached to a wall or cabinet, this is no disability. A related method, which also enables the housing to be appreciably reduced in capacity, is seen in Fig. 12. This is applicable only when the sub-assembly is mounted on a projecting baseplate, which would normally be attached by screws to the inner face of the housing. By providing a clearance hole for the body of the assembly, the baseplate can be secured to the rear of the housing in the manner shown, the rear face being, if necessary, slightly recessed to accept it. This reduces the clearance required above the sub-assembly, and so permits a lowering of the cover plate, as illustrated in the figure.

The value of these modifications lies not only in the reduced material cost,

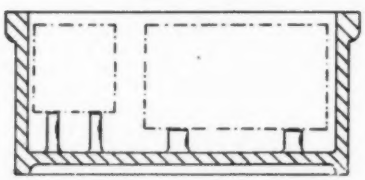


Fig. 7—Conventional mounting of sub-assemblies within a die-cast housing

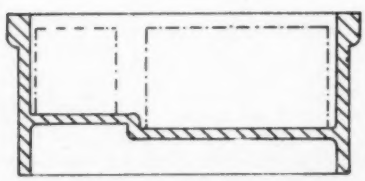


Fig. 8—The bottom of the housing is lifted to eliminate spacing pillars

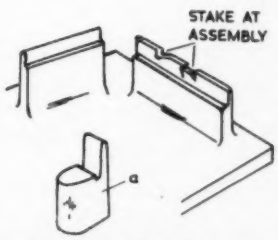
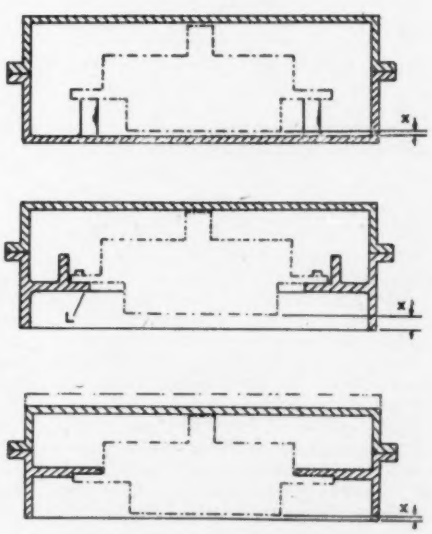


Fig. 9—Stepped ribs and buttresses for location and retention of sub-assemblies

Top right: Fig. 10—A large component housed in a completely closed die-cast shell

Centre right: Fig. 11—Here, a similar component fits into a hole in the bottom of the box-like die-casting

Bottom right: Fig. 12—Location of the component from the rear of the housing prevents removal of the former after the housing has itself been permanently secured to a wall or other surface



though this may be appreciable, but also in the fact that the production of almost any shallow box-like die-casting is facilitated by the presence of internal openings. If these are large, they may enable the component to be internally gated, thus reducing the mean distance travelled by the molten metal within the cavity. Even if not adequate, or not desired, for feeding purposes, the openings are always valuable, as providing means for the escape of air from the cavity and as locations for overflow wells to maintain thermal balance in the die and assure sound castings.

It is always difficult to assess, when converting from a sand-casting upon which much machining work is done, how much of the previously machined detail should be produced "as-cast" and how much should, as before, be left to secondary machining operations. Indeed, there is hardly any basis for laying down general principles in this regard, since identical features may well demand different treatment if the castings on which they are required differ greatly in other respects.

Thus, for example, it is possible to die-cast screw threads of quite fine pitch—20 to 30 t.p.i.—to limits acceptable for many purposes, but whereas a boss disposed in the plane of the die parting and threaded, say, $\frac{3}{8}$ in. B.S.F. for $\frac{3}{4}$ in. of its length, could be very successfully produced if forming part of a component weighing a few ounces and having a projected area of not more than about 10 in^2, it would not prove satisfactory to cast a similar thread on a component measuring 1 ft^2 or thereabouts.

This arises quite simply from the fact that as the size and weight of a die-casting increase, the achievable accuracy diminishes. It is not practicable on large castings to attempt to hold limits across the parting that will allow acceptable threads to be cast. As will be evident, the formation of an unduly heavy flash at the parting results in a great apparent ovality of small-diameter bosses, whether threaded or not.

There is, however, a further point to be considered in the particular case of external screw-threads. In the nature of things, these are invariably located on projecting portions of the casting and, in consequence, are likely to be damaged by rough handling. The larger and more weighty the component, and the greater the number of secondary operations that are to be carried out, the more probable is it that the threads will be bruised before final packing. Small die-castings of an ounce or two can be allowed to drop from the die into a tote-pan, and will show little or no sign of bruising, but large ones need to be removed with care from the die and call for careful stacking if damage is to be avoided. By and large, therefore, economy tends to lie on the side of machining, rather than casting, screw threads on large components.

Machining Operations

The planarity of die-castings is adequate for almost all purposes, and it is hardly ever necessary to face off surfaces parallel to the die parting prior to mounting a subsidiary part. Mounting faces normal to the die parting, however, though equally flat, are inclined at a slight angle to facilitate withdrawal from the cavity; these may, therefore, require to be broached should a precise angular relationship be essential. Face-broaching is almost always the most satisfactory method of producing large flat areas square to a main face; the cuts are invariably light and, the required finish being obtained in a single stroke of the press, a broaching operation is almost as simple as flash-trimming. The tools needed must, however, be more rigidly constructed than trim dies and also require heavy-duty clamping devices.

Milling is not often called for on die-cast components; when it is required, the most usual location is on or between ribs used to locate other parts. As-cast, these have a slight draft and, of course, normal casting tolerances, and a light cut on a horizontal milling machine removes the taper and brings the slot or saddle to size. Hollow milling, usually carried out on a drilling machine or with a special-duty pneumatic set-up, is of value in sizing cylindrical bosses and shanks; where some ovality of the main portion of a cylindrical component is permissible, hollow milling of the critical portion is generally to be preferred to lathe turning. It is, of course, highly undesirable to remove more of the dense outer skin of a component than is absolutely necessary, and even hollow milling should, therefore, be restricted to surfaces for which precise alignment and circularity are functionally essential. This point needs making, since one occasionally finds buyers of die-castings treating them as if they were a superior sort of sand-casting. Using the same techniques as previously, they skim them up all over and, even if they do not thereby uncover local porous patches, they certainly impair the finish, and in some degree reduce the strength.

Die-Casting Alloy for Anodizing

IN the pressure die-casting industry, a number of workers have devoted attention to the problems involved in the production of die-castings suitable for anodizing; that is, castings that will take an anodic film free from streaks or patches and one that can be dyed in a wide range of colours comparable with those obtained on wrought products.

The demand for colour-anodized die-castings has so far come largely from the building industry, where large numbers of decorative door handles, locks, etc., are used. Another market has been in the automobile trade, where car number plates frequently have silver-anodized letters and numerals. One of the firms that has pioneered these products is John Ireland (Wolverhampton) Limited, and among their recent developments is an aluminium-magnesium alloy, for which a patent has been granted,[1] that enables a consistent anodic finish to be obtained from a relatively inexpensive alloy.

Basically, the alloy has between 1 and 3·5 per cent magnesium, 0·5 to 1·5 per cent manganese, and one or more of the alkaline earth metals, calcium, strontium and barium, are added, together with a slight addition of beryllium. In this composition, the manganese serves to improve strength and corrosion-resistant properties, and the alkaline earth metals improve the grain structure and the surface finish of the castings. The small addition of beryllium reduces the tendency for the magnesium compounds to separate, a condition which gives rise to an increase in the formation of oxides and occluded gases.

A typical per cent composition is as follows: magnesium 1·4, manganese 0·75, calcium 0·20, beryllium 0·02, iron 0·15, zinc 0·10, silicon 0·2, nickel trace, and balance aluminium.

The casting technique required for the production of satisfactory die-castings for anodizing requires more rigid control than for normal pressure die-castings, and the provision of generous runners and overflows in the dies is essential if trapping of the initial oxide skin in the die cavity is to be avoided. Similar precautions also minimize turbulence in the alloy stream and welding of the alloy to the die steel. It is recommended that a die steel of 400-410 Brinell be used.

Metal is melted in a bale-out furnace, great care being taken to disturb the surface as little as possible. Standard fluxes for aluminium-magnesium alloys are added from time to time until the casting temperature is reached. For successful results, the casting temperature requires to be a little higher than that for the aluminium-silicon alloys. Under ideal conditions, it is advisable to change the crucible for the alloy, although no serious trouble has been encountered

when this has not been done. Cleanliness is essential, however, and segregation of all runners and process scrap is an integral part of successful casting procedure.

The resulting castings are capable of being dyed consistently, and yield a surface finish that requires only a light polish before anodizing. In earlier attempts to produce die-castings for anodizing it was usually necessary to break down the surface skin and remove oxide marks; thus, polishing costs were usually high. The alloy now developed minimizes the polishing required, and costs are thus reduced.

It is all too common for any finishing process to find itself compared with chromium plate, perhaps because of the tremendous quantities of chromium-plated automobile trim that are produced. The anodized die-casting cannot, of course, be produced with the brilliant lustre of high-quality chromium plate, but the slightly satin finish has a character of its own, and where colour can be used effectively it has the advantage of offering a wide range of brilliant or pastel shades.

Reference

[1] Brit. Pat. 798,341.

Men and Metals

In the New Year Honours List the following awards were announced to personalities in the world of metals:—

ORDER OF MERIT—**Field-Marshal Earl Alexander of Tunis** (chairman of Northern Aluminium Company Limited).

KNIGHTS BACHELOR — **Maj.-Gen. C. A. L. Dunphie** (managing director of Vickers Limited).

C.B.E. — **Mr. S. E. Clotworthy** (managing director of Northern

Mr. S. E. Clotworthy

Aluminium Company Limited); **Dr. Maurice Cook** (chairman, Metals Divi-

Dr. Maurice Cook

sion, Imperial Chemical Industries Limited); **Mr. I. T. Morton** (joint managing director, Clarke, Chapman and Company).

O.B.E.—**Mr. L. Essen** (senior principal scientific officer, National Physical Laboratory).

M.B.E.—**Mr. W. S. Stambridge** (consultant, Rubery Owen and Co.); **Mr. G. B. Tresilian** (lately chemist and metallurgist, Edward Curran Engineering Company).

It has been announced that the Governors of the Royal College of Science and Technology, Glasgow, have appointed **Dr. E. C. Ellwood,** chief metallurgist to the Tin Research Institute, to the Chair of Metallurgy at the College, which will shortly become vacant on the retirement of **Professor R. Hay.** Dr. Ellwood is a graduate of London University, and in 1935 went to the metallurgical division of the National Physical Laboratory. He then went to the British Aluminium Company Limited, and in 1945 was appointed lecturer in metallurgy at King's College, University of Durham. It was in 1952 that he joined the Tin Research Institute.

News from the Wolverhampton Metal Company Limited is that **Mr. Reginald Wood, Mr. Alec Gillott** and **Mr. Albert Pratt** have been appointed directors of that company.

It is reported that **Mr. P. R. R. Coad** has resigned from the board of H. J. Enthoven and Sons, his contract as managing director having terminated.

After 50 years' service with G. A. Harvey and Company (London) Ltd., **Mr. P. T. Bliss** has retired. For the past five years he has been sales director of the company.

A new member of the staff of Head Wrightson and Company Limited is **Mr. K. D. Morgan,** who is appointed a sales representative for iron and steel castings. Mr. Morgan will be based in the London office of the company.

It has been announced by Acheson Industries (Europe) Limited that **Mr. C. R. Wills,** B.Sc., has been appointed general manager of Acheson Colloids Limited, Plymouth.

Elected to the board of Crompton Parkinson Ltd., **Mr. R. R. Kenderdine** has been appointed a managing director.

Owing to illness, **Mr. J. Horridge,** who has been works manager of George Kent Limited since June, 1951, will be retiring early this year. He is being succeeded by **Mr. J. F. Willsher,** who has been appointed general works manager.

At a meeting of the Council of the Gauge and Tool Makers' Association the following officers were appointed for the year 1959:—President: **Sir Stanley J. Harley,** B.Sc., M.I.Mech.E.; vice-presidents: **Mr. A. L. Dennison, Mr. H. S. Holden, Mr. T. Ratcliffe,** and **Mr. L. E. Van Moppes.** Chairman: **Mr. G. P. Barrott;** vice-chairmen: **Mr. R. Kirchner,** M.I.Mech.E., and **Mr. H. G. Carmichael Wilson.** Hon. treasurer: **Mr. J. C. Brown.**

Leaving Birmingham after some ten years as senior lecturer in industrial metallurgy at Birmingham College of Technology, **Mr. J. F. C. Morden,** B.Sc., A.I.M., has now taken up an appointment at the Manchester Central Technical College. As this college is yet to be built, Mr. Morden will meantime be at the Department of Chemical Engineering, Fuel Technology and Metallurgy in the Manchester College

Mr. J. F. C. Morden

of Science and Technology. Mr. Morden started as a chemist in the laboratories of A. Cohen and Company Limited, and after two years at the Royal Aircraft Establishment at Farnborough he moved to the Midlands to become assistant chief metallurgist at Standard Motor Company (Aero Engines) Limited. After the second world war he joined Bound Brook Bearings Limited as chief metallurgist, and in 1947 joined the staff of Coventry Technical College. In 1948 he went to the Birmingham Central Technical College, as it was then known. He took his B.Sc., Hons. Degree (Eng.) Metallurgy, of London University, at the Sir John Cass College, London, in 1939.

An announcement has been made to the effect that **Mr. H. P. N. Benson** has been appointed deputy managing director of the A.P.V. Company Limited.

Appointed as assistant managing director of Thos. Firth and John Brown Limited, **Mr. A. Broomhead** has also been appointed chairman of the company's wholly-owned subsidiary, Firth-Derihon Stampings Ltd. Mr. Broomhead joined the organization in 1926 and was appointed a director in 1953.

Foundry Briefs

Corrosion at Metal-to-Plastics Joints

Problems that arise from the deterioration or failure of a product in service are often passed back to the foundryman, whether or not they are directly concerned with foundry practice. In the instance reviewed here, a metallurgical problem, involving the proximity of two metals and corrosion resulting from their differing electrode potentials, was encountered. The investigation is a fairly typical example of enquiries encountered outside the sphere of strict foundry work.

By COUNSEL

SERVICE complaints may arise from a variety of causes, and although many such complaints have their origin in founding defects, there are also many others in which the conditions of service are the source of the trouble. There are also assembly considerations, machining defects, and errors of fundamental design, which may all be responsible for, or contribute to, the unsatisfactory service life of a given part. In the instance reviewed here, in which corrosion products appeared at the junction of a metal saucepan and its plastics handle, the immediate source of the trouble was the contiguity of unsuitable materials, but this in itself was evidence of a poor design, one in which insufficient thought had been given to the problems of assembly and the metallurgical considerations involved.

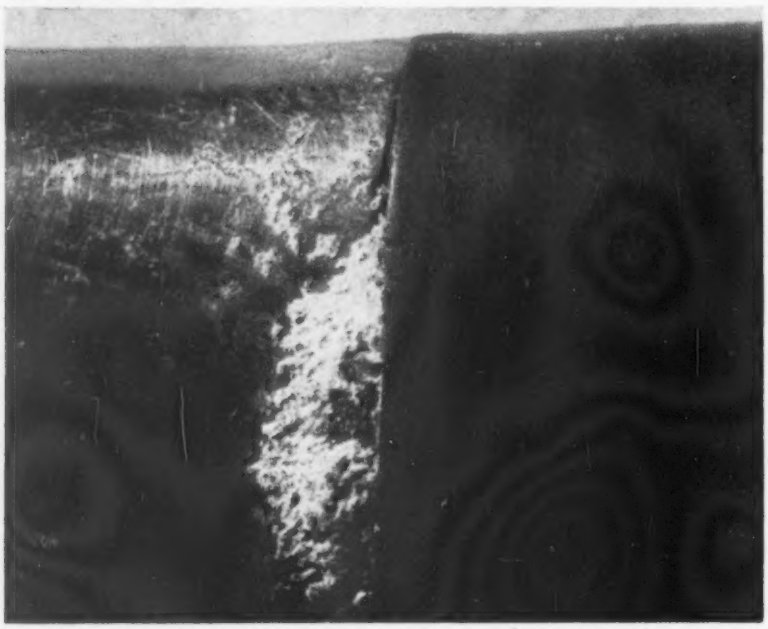


Fig. 1—Corrosion deposit appearing as a white powdery substance around the junction of the iron core and aluminium casting

Fig. 2—Deposit around the "foot"

The particular complaint which gave rise to this investigation concerned a saucepan handle, cast in aluminium alloy (LM6), and although the casting itself was reported to be sound, corrosion deposits had accumulated during service around the junction of the casting with the plastics handle, and also in the centre of the underside of the foot. The corrosion deposit appeared as a white powdery substance (Fig. 1).

On examination of the handle, an iron wire was found to extend down the centre of the handle and into the casting, this being, apparently, the means of securing the plastics handle to the aluminium alloy saucepan casting.

The corrosion extended right down to the wire, and the corroded area on the "foot" corresponded to the point at which the iron wire protruded. A section taken through the back of the "foot" revealed a large cavity round the wire in which, as shown in Fig. 2, there was also a considerable accumulation of white corrosion product. At one point the casting wall had been penetrated by the corrosion.

It was apparent, from the conditions described, that galvanic action had occurred between the iron wire and the LM6 alloy. The attack in all probability started round the wire in the cavity and later extended to the crack between the plastics handle and the metal. Such an attack could only arise if the casting had been stored in a damp atmosphere or if moisture was allowed to accumulate in the cavity.

In order to avoid repetition of this type of attack, it was recommended that, if iron wire must be used to link the plastics to the aluminium alloy, provision should be made to ensure a complete seal between them. Further, the wire should be completely encased in the aluminium and not penetrate to the outside of the casting. If such junctions of iron and aluminium did extend to the outer surface, corrosion could be expected, due to the difference in electrode potential between the two metals.

[*This note is based on an investigation carried out for one of their customers by Foundry Services Ltd.*]

Industrial News *Home and Overseas*

Vitreous Enamel and H-Power

One of the latest applications of vitreous enamel was recently announced by **Ferro Enamels Ltd.**, of Wolverhampton. For some time this company has been carrying out experimental work connected with "Zeta" under continuous contract at Harwell. This has resulted in the manufacture of the first vitreous-enamelled torus—part of the equipment used for harnessing the power of the H-bomb.

The torus is fabricated in aluminium in segments, and has been coated with vitreous enamel on the inside to give electrical insulation against 200,000 amps. The company met with many technical difficulties in enamelling the shape of the torus, and there were further complications in that a far higher standard of finish was required than that which would be commercially acceptable.

The surface had to be free from the most microscopic pinhole which could be caused by dust in the atmosphere. The company found it necessary to pressurize their development laboratory and to filter the air drawn into it. The finished segment was then checked for pinholes with an arcing probe. The company feels that there is no doubt at all that, arising from this strictly scientific work, great strides have been made in the development of enamelling techniques for coating aluminium which are bound to bring great benefit to normal commercial manufacture.

Fire Prevention

Facilities available to the occupants of buildings for the control and extinguishing of fire consist of a number of devices, including portable appliances (extinguishers and buckets), manually operated fixed installations, such as hydrants and hose reels, and automatic installations such as automatic sprinkler systems.

From the **Fire Protection Association** comes a most useful booklet which explains briefly in 16 pages the different types of fixed installation that are available, and also gives some guidance on their installation. The suitability of the various agents for the main types of risks is also discussed. The title of the booklet is "Fixed Fire Extinguishing Equipment in Buildings," and it can be obtained from the offices of the association at 31-45 Gresham Street, London, E.C.2, on payment of 1s. 6d.

Birmingham Exhibit

Industrialists in the Birmingham area will be interested in an exhibition of electrical timing and automatic control equipment which is being made by **Electrical Remote Control Co. Ltd.**, on February 10 and 11 next, at the Birmingham Engineering Centre. The exhibition will be open from 10 a.m. to 9 p.m. on both days.

Copper Disposals by B.O.T.

On the last day of the old year, the Board of Trade announced that they are offering for sale the whole of their remaining stocks of copper, amounting to about 30,000 tons. Of this, 4,000 tons consists of cakes, and will be sold by negotiation. The remaining 26,000 tons will be offered for delivery and pricing during the period February to November, 1959, at a rate of about 2,600 tons a month. Of the 26,000 tons, 11,500 will be offered to the original suppliers or their agents, and about 14,500 tons by open tender. Any material unsold at the tender will be sold by negotiation.

Application may be made to the Board of Trade, General Division 7, Lacon House, Theobalds Road, W.C.1, for tender forms.

Aluminium and India

Recent news from India is to the effect that the Government has announced its decision on a number of reports made by the Tariff Commission. The Government accepts, *inter alia*, the recommendation that protection to the aluminium industry should be continued for a further period of two years, till December 31, 1960, and the existing rate of duty of 35 per cent *ad valorem* should be maintained on (1) aluminium in any crude form, including ingots, bars, blocks, etc.; (2) aluminium manufactures — plates, sheets, circles, strips and foil, including foil in any form or size, ordinarily used as parts and fittings of tea chests.

Gas Scrubber Contract

A new contract for a P.A. Venturi gas scrubber has been given to **Chemical Construction (G.B.) Ltd.**, by John Allen and Company (Glenpark) Ltd., for the removal of lead fume from gases from rotary and reverberatory furnaces at their Glasgow works.

Analytical Chemistry

A meeting of the Midlands Section of the **Society for Analytical Chemistry** is to be held on Tuesday next, January 13, at 6.30 p.m. in the Mason Theatre, The University, Edmund Street, Birmingham, 3. A discussion on "The Analytical Chemistry of Cobalt and Nickel" will be opened by Mr. A. J. Brookes, A.R.I.C., A.C.T., senior development chemist, Wiggin Chemical Laboratory.

For Planing Metals

A new unit has just been introduced by **Simmonds Aerocessories Ltd.** (Surform Division). This is the Surform "Craftsman" plane, which is fitted with the same blade as the standard range of Surform tools. Its 500 tough teeth, set at a scientifically developed angle in a 10 in. hardened and tempered Sheffield tool steel blade, will be found suitable for planing a variety of materials, including aluminium, brass, copper and lead.

A Removal

It has been announced by **Birlec Limited** that their South-Eastern area office has now been transferred to Crown House, Aldwych, London, W.C.2. The area office of Birlec-Efco (Melting) Ltd. will also be housed at this address. In addition to providing a sales organization and service facilities in the Greater London area, the two area offices also serve the counties of Middlesex, Essex, Kent, Surrey, Berkshire, Buckinghamshire, Bedfordshire, Hertfordshire, Cambridgeshire, Sussex, Hampshire, Huntingdonshire, Isle of Ely, Suffolk and Norfolk.

Enquiry from U.S.A.

Interested in buying direct from U.K. manufacturers of copper tubes, Mr. M. E. Linett, Specialty Products Co., 619 S. Matlack Street, West Chester, Pa., has told the British Consulate-General at Philadelphia that the details of his enquiry are as follows:—

Copper tube,, $\frac{1}{4}$ in., $\frac{3}{8}$ in., $\frac{1}{2}$ in. and $\frac{3}{4}$ in. inside diameters, standard tube with various wall thicknesses; 0·035, 0·040 and 0·049 (types K and L) in coils 50 ft. long. Quotations should be for quantities. Manufacturers interested in this enquiry are advised to contact the buying company direct by air mail. It is stressed by the Board of Trade that quotations should show both f.o.b. and c.i.f. prices in U.S. currency.

A London Conversazione

Readers are reminded of the Conversazione which has been arranged by the Corrosion Group of the **Society of Chemical Industry,** to be held in the Battersea College of Technology, London, on Thursday, January 22 next, at 6.30 p.m. Exhibits will be made illustrating research and development. Full details of this event may be obtained from the assistant secretary to the society at 14 Belgrave Square, London, S.W.1.

Canadian Production

Production of Canadian minerals has shown its first annual decline in 15 years, the Bureau of Statistics has reported. It estimated total 1958 production at 2,122,153,000 dollars, down by three per cent from the previous year's record 2,190,322,000 dollars. Uranium became Canada's leading metal during the year, with a 12-month production value of 290,228,000 dollars, by far a record and more than double the previous year's 136,304,000 dollars, the Bureau said.

Hungarian Magnesium

According to reports from Vienna, production of magnesium metal will begin in Hungary during the first half of the current year. Raw material will be locally mined dolomite. The use of this metal in industry has been studied for some time by various research branches, and a pilot plant has been operated at Apoc, in the Heves area. By 1960, it is expected that output will have expanded sufficiently to cover all the country's requirements for this metal.

Electric Ovens

A new range of medium capacity electric ovens has recently been introduced by **Hedin Limited.** These ovens are a redesigned and improved version of an earlier successful product of the company. They are designed with vertical airflow for floor-loading, and trolleys and guide rails can be provided as required to facilitate charging.

Double-skin steel construction is employed with fibre-glass insulation, and frameworks are all-welded angle and

channel iron. Doors are normally double-hinged and fitted with asbestos heat seals. However, when it is necessary to save floor space, a vertical lifting door, counter-balanced for easy manual operation, can always be provided. In the closed position, this is secured with screw clamps.

Internal dimensions fall generally within the range 5 ft. high by 4 ft. wide by 4 ft. deep, up to 8 ft. high by 8 ft. wide by 8 ft. deep.

Malayan Tin Shipments

Tin shipments in December from Singapore totalled 49½ tons, according to the Straits Trading Company. This compared with 96¾ tons shipped in November. December shipments were as follows: United States 7, Europe 16, Japan 5, Pacific 15¼, India 1¼, Australasia 1¼, and Middle East 3¼.

Shipments from Penang totalled 1,732½ tons, compared with 4,089 tons in November. December shipments were as follows: United States 730, Europe 162, Japan 526¼, Pacific 1½, India 174, South America 70¾, Africa 13, Australasia 45, Middle East 10 tons.

U.K. Automation Device in U.S.A.

Some eighteen months ago, **Press Equipment Ltd.,** of Birmingham, decided to introduce into the United States of America their "Mechanical Hand" second operation press feeder, of which, we understand, there is no American equivalent. This effort on the part of the British company proved an unqualified success, and this has recently been confirmed by the publication in the *Microphone,* a journal of the Western Electric Company of Chicago, of an illustrated article dealing with the uses of the "Mechanical Hand." This is a well-merited tribute to the British manufacturers.

Development Plans

In a statement recently issued, Mr. R. W. Holmes, chairman of the Hollow-ware Division of the **Vitreous Enamel Development Council,** says that plans for 1959 are now well advanced, and include council representation at general and specialized exhibitions, in addition to strong national advertising campaigns.

In addition, comprehensive display plans have been made. Information and educational programmes will start early in the New Year.

Safety Equipment

New developments in the field of safety goggles for industrial workers have been announced by Fleming Safety Equipment division of **J. and R. Fleming Ltd.** To deal with the problem of steaming and fogging-up of safety goggles, this firm has designed a lens cleaning and de-misting cabinet. The liquid, which is dispensed in a fine spray when the lever on either side of the cabinet is depressed, cleanses as it de-mists. As a piece of really clean cloth is usually difficult to obtain in the average factory, tissues are provided in the cabinet, together with space for their disposal after use. Neither liquid nor tissues will damage plastics materials.

It is estimated by the company that, where this unit is installed, at least twelve goggles or spectacles can be treated at a cost of one penny, and the operation of cleansing and de-misting takes seconds only.

Two new types of goggles have also been introduced recently by this company. A transparent goggle, particularly suitable for use in places where chemicals are much employed, is made from non-corrodible chemically-resistant materials. The lens itself is of "Cobex," and the surround is made from flexible polyvinyl chloride. This goggle can be worn over correction spectacles, and two independent flaps at the bridge completely close the gap at the sides of the nose.

The second production is a lightweight Celtone spectacle particularly designed for the use of visitors to works, etc. This goggle is light in weight, can be worn over correction spectacles, and gives a wide field of vision. Both frame and lenses are crystal clear.

An Annual Function

Advance notice is given of the second annual dinner and dance of the Bristol and South West Branch of the Institute of Metal Finishing. This function will be held on Thursday, February 26, 1959, at the Royal Hotel, College Green, Bristol. Tickets, price 27s. 6d. each, may be obtained from Mr. R. A. Wilding, hon. sec. of the branch, at 11 Fenton Road, Bristol, 7.

Pensioners' Luncheon

On Saturday of last week, 28 people in their eighties were included among nearly 700 pensioners who were given a luncheon in Birmingham by the Metals Division of **Imperial Chemical Industries Limited,** at Witton. All these pensioners were former employees of the company, and many came from some distances, such as Hampshire, Cornwall and Devon, to attend the function.

Exhibiting in Australia

During the two weeks commencing February 23 next, the first Australian exhibition of automatic analytical instruments is to be held in the Sydney showrooms of Watson Victor Ltd. These instruments, with a total value of about £36,000, will be representative of those made by the London company of **Hilger and Watts Ltd.,** and it is indicative of the faith this firm has in the Australian market (and in the willingness of the Australian manufacturer to accept new methods) that they are prepared to make so heavy an outlay for exhibition purposes. The company's sales director, Mr. D. R. Stanley, will be at the exhibition, together with technical specialists from this country.

Industrialists and scientists will be invited to the exhibition, and will be able to see the instruments in full working order. Samples of steel and non-ferrous alloys will be tested and analysed, and the results presented in no more than a few minutes. In a country with a large agricultural community, and where industrialism is rapidly spreading, so that soil research and metallurgical and other forms of analysis are equally important, this exhibition will undoubtedly arouse wide-spread interest.

Craftsmanship Certificates

Certain revisions have been made in the conditions of award of the Gauge and Tool Makers' Association Certificate of Craftsmanship which may be applied for in respect of gauge and tool making, instrument manufacture, special-purpose machines and tooling, press tool, die, and mould making, etc. Applications for the certificate will be considered from young men who—(a) have served a bona fide indentured apprenticeship in precision engineering, with special reference to gauge and tool making and precision equipment allied thereto; (b) have also passed the Final Examination of the City and Guilds of London Institute Course in Machine Shop Engineering; or have obtained the ordinary National Certificate in Production Engineering, or in Mechanical Engineering endorsed in Workshop Technology.

Applicants need not necessarily be employed with firms that are members of the association, nor have served their apprenticeships with a member-company, but applications for the certificate are not normally entertained if submitted more than two years after date of completion of apprenticeship. Copies of the application form may be obtained from the offices of the Gauge and Tool Makers' Association, Standbrook House, 2-5 Old Bond Street, London, W.1.

Oil-Firing Course

It is learned from the **National Industrial Fuel Efficiency Service** that the oil-firing course announced to be held next week was filled very soon after details of the course were given out.

A further course has, therefore, been arranged at Ailsa House, Kings Road, Reading, for April 14-16 next, and as some of the places have been taken up by those who could not be accepted into the January course, early enrolment is recommended. The course is designed to meet the needs of industrial plant engineers, heating engineers, and supervisory staff responsible for oil-fired boiler plant. The fee for the course, exclusive of hotel accommodation, is six guineas. Full particulars, application forms and a course syllabus may be obtained from the offices of the Service at 71 Grosvenor Street, London, W.1.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange warehouses amounted to 16,918 tons, and were distributed as follows at the end of last week:—London 6,107, Liverpool 8,301, and Hull 1,510.

Stocks of refined copper amounted to 5,271 tons, and were distributed as follows:—London 3,025, Liverpool 1,746, Manchester 250, and Birmingham 250.

Foundry Equipment Wanted

The British Consulate-General at Chicago has been advised by Mr. R. S. Crichton, President of J. D. Wilson Company Inc., of 4452 West 5th Avenue, Chicago, that he proposes to visit Europe this coming Spring, and wishes to investigate potential sources of supply for refractories and miscellaneous foundry materials, equipment and supplies.

Amongst the foundry materials and related products most likely to be of interest at this time, particular mention is made of super duty refractories for high temperature service, either high alumina or mullite, though the firm would be willing to investigate any specialized refractories having high temperature characteristics, or anything which could be described as a new development in this field. It is also mentioned that the company would be willing to consider high temperature insulation for industrial furnaces, as a further example of the type of product they would be qualified to handle.

U.K. firms interested in this enquiry are advised to communicate direct with

Mr. R. S. Crichton in order to permit initial evaluation prior to his forthcoming visit, and it is also suggested that quotations should be submitted in dollars, preferably on a c.i.f. basis.

Italian Copper Trade

Recent news from Rome states that Italy's imports of crude copper for smelting and refining in the first nine months of 1958 were 1,832·3 metric tons, valued at 579,807,000 lire, of which 501·1 metric tons were temporarily imported, according to the Central Statistical Office. Main suppliers were Indonesia 101·3 metric tons, and Chile 1,604·1.

Imports of refined copper, in slabs, ingots, shot and powder were 67,552·9 metric tons, valued at 20,796,125,000 lire, of which 13,469·5 were imported temporarily. Main suppliers were Belgium-Luxembourg 2,621·8 metric tons; Britain 7,938·7; Belgian Congo 13,076·9; Rhodesia and Nyasaland 5,329·1; South Africa 3,995·8; Canada 4,163·4; Chile 9,545·7, and the United States 15,763 metric tons.

Foundry Plant Scheme

Recent news from Derby is to the effect that **Qualcast Limited** propose to embark upon the installation of a new foundry plant costing about £½ million. It is hoped that the new plant will be in operation by midsummer.

Australian Prospects

Australian base metal producers will be faced with a world surplus for some time, the Minister for National Development, Senator W. H. Spooner, has stated in a comment on a review made by the Bureau of Mineral Resources of the copper, lead, zinc, and tin industries. Senator Spooner said the future market for lead was likely to be much more competitive than for copper and zinc, because of the limited market expansion possibilities for lead. The present world surplus production capacity of lead and zinc would last longer than that of copper.

News from Rhodesia

According to reports from Cape Town, the Bulawayo foundry of Rhodesia Railways Limited has allocated about one-fifth of the total floor area for the production of brass castings, and in an average month the production of non-ferrous castings averages 200,000 lb. Among the larger items produced in this foundry are the 450 lb. gunmetal locomotive axle boxes, which are now being produced at the rate of up to twenty daily.

Aluminium Sheet

One of the latest products of the **Northern Aluminium Company Ltd.** is "Noralduct," a solid aluminium sheet having internal systems of passages and ducts. It is stated to be particularly suitable for heat transfer equipment and, as the integral passages can follow almost any complex continuous pattern that can be drawn on paper, there are many other possibilities.

Sheets of Noralduct can be formed after manufacture, we understand, as are those used in refrigerator evaporator components, for example. Either a plain or an impressed pattern finish is available, and colour can be included in the product design as there are no welds to spoil the appearance of an anodized finish. In a folder issued by the company is included a list of the present uses of this aluminium sheet and some of the possible ones, together with a short description of its manufacture, a guide to its present tolerances and manufacturing limits.

Aluminium in Norway

During the first year of operations (1958) Mosjoen Aluminium A/S produced 16,500 metric tons of virgin aluminium. The major part of this output went to Britain, West Germany, and Belgium. Output for 1959 is put at 24,000 tons, most of which has already been sold. If negotiations with a power company for extra supplies of electricity are successful, output may be raised to 30,000 metric tons.

Welded Metal Masts

One of the features of the **National Boat Show,** held at Olympia, London, during the past two weeks, is the increasing use of welded metal masts in small racing craft. These British-made welded metal masts are also becoming an increasing export to many countries overseas. In recent years there has been a trend among designers and skippers of small dinghies to improve the racing performance of these craft with fabricated masts from aluminium-magnesium alloy. The principal advantages of the masts, manufactured by Sheet Metal Craft Ltd., are lightness in weight, strength and resistance to corrosion. They also provide a clean lead-in to the mainsail and are predictable for flexing and bending qualities.

Magnesium-aluminium alloy extruded sections are used for manufacturing the masts. These vary in weight according to the size of the boat for which they are designed. Tapering, to reduce weight aloft, is effected by making a longitudinal cut in the tube, which is then rewelded by the Argonarc process. This process gives deep penetration and minimum distortion, and since no flux is used with this system, the post-welding cleaning problem is eliminated. It has been found to be economical, as 12 complete masts can be welded with one 200 ft³ cylinder of argon.

The mast is made watertight with capping of the summit, and a wooden plug is inserted at the base. Near the base, sheaves for halyard outlets or winches are fitted with the aid of Chobert rivets. Above deck level, the track section is opened to facilitate a sliding goose neck for the boom attachment.

In some instances, a rectangular alloy section is welded into the mast to provide a housing for the sheave cage of the jib. This allows the jib halyard to pass right through the mast into the sail track. In other instances, at a point near the jib sheave cage, a small semi-circular alloy tube is fitted through the mast, allowing the spinnaker halyard to pass down through the sail track. Both these fittings are welded into place by the Argonarc process.

French Metal Prices

It has been reported from Paris that the French Ministry of Industry and Commerce has decided to modify the trading scheme for lead and zinc in the light of the recent monetary reforms and the removal of quantitative import restrictions on the two metals. In future, French prices of the two metals will be based on the daily quotation on the London Metal Exchange. Previously, the prices followed New York but were given considerable protection. As a result, a daily price fixing will take place, although changes will be made only if the London fluctuations are sufficiently wide.

French prices will also take into account reduced customs protection and other duties on foreign metal. Under the new rules, the import duty has been reduced from 8 to 7·2 per cent for lead, and from 12 to 10·8 per cent for zinc, if supplied from another Common Market country. If imported from the "non-six" O.E.E.C. countries, the previous customs duty of 8 and 12 per cent still applies, but this is considered to be temporary, until the six Common Market countries have established their common external customs tariffs for these items. In addition to the customs duty, importers of lead and zinc have also to pay a new tax of 2 per thousand *ad valorem*, and a duty of three per cent of the import duty.

Price increases in zinc have been limited to some 5 per cent, despite the fact that devaluation amounted to 17·55 per cent. For lead, which was very strongly protected against foreign competition prior to import liberalization, the price is now even lower than before, at 107 francs per kilo as against 115 francs.

Aluminium in U.S.A.

Despite lack of market pressure, the United States aluminium industry expanded its primary metal production capacity during 1958 by nearly 19 per cent, adding more than 345,000 tons to its potential, according to the Annual American Metal Market Industry Survey.

Added to previously existing facilities, this increased the domestic effective pig and ingot productive capacity to a new peak of 2,184,250 tons. At the start of 1958, the figure was 1,839,000 tons. The publication added that inclusion of 821,000 tons of effective capacity of Canada's two producers provides a productive potential of 3,005,250 tons of primary aluminium for North America.

Forthcoming Meetings

January 12 — Institution of Production Engineers. Sheffield Section. The Grand Hotel, Sheffield. "Non-Destructive Testing." Paul Fox. 6.30 p.m.

January 13—Institute of Metals. South Wales Local Section. Department of Metallurgy, University College, Singleton Park, Swansea. "The Zinc Blast Furnace." S. W. K. Morgan. 6.30 p.m.

January 13 — Society of Analytical Chemistry. Midland Section. The University, Edmund Street, Birmingham. "Analytical Chemistry of Cobalt and Nickel—Discussion." A. J. Brookes. 6.30 p.m.

January 14—Incorporated Plant Engineers. Dundee Branch. Taypark Hotel, West Ferry, Dundee. "Paints and Anti-Corrosives." R. A. Sim. 7.30 p.m.

January 14—Institute of Metal Finishing. Organic Finishing Group. British Institute of Management, 80 Fetter Lane, London, E.C.4. "Recent Developments in Paint Applications." "Curtain Coating," F. W. Summerland. "Electrostatic Hand Spraying," R. Tilney. 6.30 p.m.

January 15—Leeds Metallurgical Society. Lecture Room C, Chemistry Wing, The University, Leeds, 2. "The Ultimate Structure." T. J. Parry and S. Newton. 7.15 p.m.

Metal Market News

APART from tin, which put up a poor show last week, the markets over the turn of the year did not do too badly, both zinc and lead closing higher on balance. Remarkable strength was displayed by stock markets, both gilt edge and industrials improving in value. The decision on the convertibility of sterling was accepted as a favourable omen, and the action taken by France was also well received. The free trade area came into existence on January 1, but it is, of course, too early as yet to say much about that. There is certainly a decidedly hopeful feeling so far as the commodity markets are concerned, and, as already mentioned, the investing public is optimistic in its attitude to the future level of business. No special feature emerged in the United States over the turn of the year, but Wall Street has been achieving new high levels and there does not seem to be any reason to suppose that the top has yet been reached. The event of the week was, of course, the announcement by the Board of Trade that it intended to dispose of the balance of its stocks of copper, amounting to some 30,000 tons. Of this, it was stated that about 4,000 tons in the form of cake would be sold by private negotiation, while a further 11,500 tons would be put on first refusal to the producers. The remaining 14,500 tons, which presumably comprises wirebars and cathodes for the most part, would be sold by tender to the highest bidder for pricing and delivery over ten months from February to November.

The fact that the news of this sale by the Board of Trade was published on the last day of the year created a bad impression, and the authorities were under criticism for what was considered to be a most maladroit action. Generally speaking, a reasonably firm market is anticipated on December 31, a condition of affairs eminently acceptable to the trading community, whether merchant, dealer or manufacturer, but on Wednesday the reverse happened, for the market dropped by £4 from Tuesday's high point of £224 5s. 0d. On the Metal Exchange, comment was that but for the startling news of the projected sale of government stocks the year would have ended with the price at £225, and this could very well have occurred, for the tendency on the two previous days was decidedly firm. In the event, the close was 10s. above the lowest point reached, at £220 15s. 0d. cash and £220 three months, the backwardation having widened from 5s. to 15s. The turnover in the shortened week, January 1 being a *dies non* for the metal markets, was about 5,350 tons without Kerb business. Stocks of copper in official warehouses declined by 150 tons to 5,821 tons, and it appears that the downward tendency is likely to continue.

Stocks of tin were also lower, but only to the extent of 20 tons, which brought the total down to 16,068 tons. Dealing in the metal was rather restricted, and the turnover amounted only to just over 500 tons. Keeping in step, and maintaining the contango of £2 10s. 0d., both cash and three months lost £8, to close at £746 and £748 10s. 0d. for the respective positions. Lack of demand by consumers is blamed for this rather sorry display on the tin market, for statistically the metal appears to be in a pretty favourable position. However, for the moment it would seem that the tin market is heading for a still lower level. In many ways, lead and zinc put up the best show, for after a turnover of 4,225 tons, lead gained 17s. 6d. for prompt and 12s. 6d. forward. In zinc, sales amounted to 5,525 tons, prompt being up 15s. at £75 10s. 0d. and forward £1 better.

Birmingham

Quiet conditions continue in the trades using non-ferrous metals in the Midland area. The strength of the motor trade is maintained, and this helps a number of associated trades. The cycle industry, on the other hand, is short of orders, and is pressing for a reduction of Purchase Tax. The building trade is slow and outdoor operations are being hindered by bad weather. For the first time for some years, there has been some slackness in the building of railway rolling stock, and one firm in the Birmingham area has been forced to reduce its labour force. This is stated to be due to cuts in expenditure by British Railways and also to lack of contracts with overseas countries, where competition has become increasingly keen recently.

The process of reducing stocks of iron and steel seems likely to continue for some months yet. Although there is less surplus material than there was six months ago, the tonnage is such that users are not likely to come into the market. It is noteworthy that with the increased availability of steel from modern plant there is less need for importation. This applies to semi-finished steel, plates and sheets. Foundries making light castings are still working below capacity, but the engineering industries are giving good support in the matter of heavy castings. Pig iron supplies are more than sufficient for the present activity amongst the foundries. Orders for heavy structural steel are scarce.

New York

The copper market has been quiet but steady. Copper futures, after softness in early dealings, firmed on new buying in active volume, including exchanges. Custom smelter and producer copper was quiet, influenced by the holiday week. One leading producer source said he looked for continued good copper business in the first quarter, with a build-up of fabricators' copper stock developing. Tin was quiet and a shade easier. There was light business in lead and zinc.

U.S. mines and wells yielded 16,400 million dollars of minerals in 1958—almost 1,800 million dollars below the value of 1957 productions, the Interior Department said in a preliminary report. Lower average prices along with cutbacks in the volume of production of several important commodities, reduced the value of metals production to 1,129 million dollars from the 1,580 million dollars in 1957, the Department reported. Output of copper was off about ten per cent, lead and zinc 23 per cent, while silver output dropped to the lowest level since 1946.

Anaconda Company has announced plans for more vigorous participation in the U.S. aluminium market. Two wholly-owned subsidiaries, American Aluminum Company and Cochran Foil Corporation, have been merged into another subsidiary, Anaconda Aluminum Company, making it a single organization with assets of over 140,000,000 dollars. Mr. Clyde E. Weed, Anaconda chairman, said Anaconda Aluminum Company would be an integrated firm embracing each phase of aluminium production.

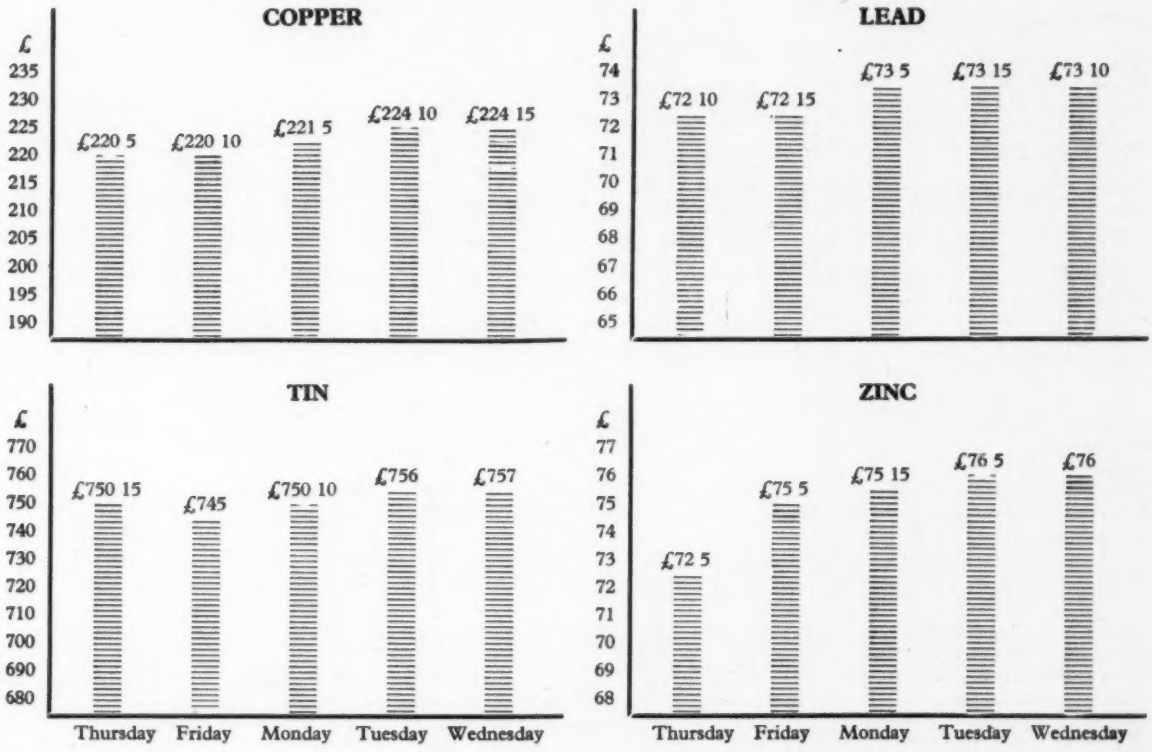
The Philippines

New measures designed to encourage foreign investment in the development of nickel and iron deposits in the southern Philippines are under study, it is reported from Manila. A Government committee formed to work out the new measures recently discussed details of a public bidding to be called shortly on the development project of the nickel reservations in Surigao Province in north-eastern Mindanao Island. The public bidding, second to be held on the project, will carry conditions stipulated under an amended Nickel Law passed during the last Congress. There were no bidders during the first public bidding, mainly due to the fact that terms laid out in the original Nickel Law were considered to be too unfavourable for foreign investors.

As amended last June, the Nickel Law would now allow foreign capital invested in the development project to retain 65 per cent of the net gain, or 6·5 per cent of the gross income, whichever might be lower. The original law provided for foreign capital to retain only 50 per cent of the net gain, or 5 per cent of the gross income, whichever might be lower. The Philippine Government would get the balance.

METAL PRICE CHANGES

LONDON METAL EXCHANGE, Thursday 1 January 1959 to Wednesday 7 January 1959



OVERSEAS PRICES

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≏ £/ton		Canada c/lb ≏ £/ton		France fr/kg ≏ £/ton		Italy lire/kg ≏ £/ton		Switzerland fr/kg ≏ £/ton		United States c/lb ≏ £/ton	
Aluminium			22.50	185 17 6	210	157 10	375	221 5	2.50	212 10	26.80	214 10
Antimony 99.0					220	165 0	445	262 10			29.00	232 0
Cadmium					1,350	1,012 10					145.00	1,160 0
Copper												
Crude												
Wire bars 99.9							435	256 12 6				
Electrolytic	31.00	228 2 6	28.00	231 5	316	237 0			2.95	250 15	29.00	232 0
Lead			11.75	97 0	115	86 5	176	103 17 6	.90	76 10	13.00	104 0
Magnesium												
Nickel			70.00	578 5	900	675 0	1,300	767 0	7.50	637 10	74.00	592 0
Tin	106.25	782 0			1,070	802 10	1,460	861 10	9.00	765 0	98.00	784 0
Zinc												
Prime western			11.50	95 0 0							11.50	92 0
High grade 99.95			12.10	100 0 0								
High grade 99.99			12.50	103 5 0								
Thermic					111.00	83 5						
Electrolytic					119.00	89 5	176	103 17 6	.91	77 7 6	12.75	102 0

NON-FERROUS METAL PRICES

(All prices quoted are those available at 2 p.m. 7/1/59)

PRIMARY METALS

		£	s.	d.
Aluminium Ingots	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		9	6
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		16	0
Columbite	per unit		—	
Copper H.C. Electro	ton	224	10	0
Fire Refined 99·70%	„	223	0	0
Fire Refined 99·50%	„	222	0	0
Copper Sulphate	„	74	0	0
Germanium	grm.		—	
Gold	oz.	12	10	0½
Indium	„		10	0
Iridium	„	20	0	0
Lanthanum	grm.		15	0
Lead English	ton	73	10	0
Magnesium Ingots	lb.		2	3
Notched Bar	„		2	9½
Powder Grade 4	„		6	3
Alloy Ingot, A8 or AZ91	„		2	8
Manganese Metal	ton	290	0	0
Mercury	flask	74	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	
Palladium	„	5	15	0
Platinum	„	19	10	0
Rhodium	„	40	0	0
Ruthenium	„	15	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	3⅞
Tellurium	lb.		15	0
Tin	ton	757	0	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	74	10	0
Dust 95/97%	„	109	0	0
Dust 98/99%	„	115	0	0
Granulated 99+%	„	99	10	0
Granulated 99·99+%	„	113	15	0

******Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

Aluminium Alloy (Virgin)		£	s.	d.
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10	„	221	0	0
B.S. 1490 L.M.11	„	215	0	0
B.S. 1490 L.M.12	„	223	0	0
B.S. 1490 L.M.13	„	216	0	0
B.S. 1490 L.M.14	„	224	0	0
B.S. 1490 L.M.15	„	210	0	0
B.S. 1490 L.M.16	„	206	0	0
B.S. 1490 L.M.18	„	203	0	0
B.S. 1490 L.M.22	„	210	0	0

		£	s.	d.
†Aluminium Alloys (Secondary)				
B.S. 1490 L.M.1	ton	142	10	0
B.S. 1490 L.M.2	„	152	0	0
B.S. 1490 L.M.4	„	169	0	0
B.S. 1490 L.M.6	„	186	0	0

†Average selling prices for mid October

***Aluminium Bronze**				
BSS 1400 AB.1	ton	225	0	0
BSS 1400 AB.2	„		—	
***Brass**				
BSS 1400-B3 65/35	„	144	0	0
BSS 249	„		—	
BSS 1400-B6 85/15	„	195	0	0
***Gunmetal**				
R.C.H. 3/4% ton	„		—	
(85/5/5/5)	„	178	0	0
(86/7/5/2)	„	188	0	0
(88/10/2/1)	„	239	0	0
(88/10/2/½)	„	248	0	0
Manganese Bronze				
BSS 1400 HTB1	„	184	0	0
BSS 1400 HTB2	„		—	
BSS 1400 HTB3	„		—	
Nickel Silver				
Casting Quality 12%	„		nom.	
„ „ 16%	„		nom.	
„ „ 18%	„		nom.	
***Phosphor Bronze**				
B.S. 1400 P.B.1 (A.I.D. released)	„		—	
B.S. 1400 L.P.B.1	„	201	0	0
Phosphor Copper				
10%	„	238	0	0
15%	„	241	10	0

******Average prices for the last week-end.*

Phosphor Tin				
5%	ton		—	
Silicon Bronze				
BSS 1400-SB1	„		—	
Solder, soft, BSS 219				
Grade C Tinmans	„	355	6	0
Grade D Plumbers	„	287	3	0
Grade M	„	389	6	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9 „	„		—	
Zinc Alloys				
Mazak III	ton	107	0	0
Mazak V	„	111	0	0
Kayem	„	117	0	0
Kayem II	„	123	0	0
Sodium-Zinc	lb.		2	6½

SEMI-FABRICATED PRODUCTS

Prices of all semi-fabricated products vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium			£	s.	d.
Sheet 10 S.W.G.	lb.			2	8½
Sheet 18 S.W.G.	„			2	10½
Sheet 24 S.W.G.	„			3	1½
Strip 10 S.W.G.	„			2	8½
Strip 18 S.W.G.	„			2	9½
Strip 24 S.W.G.	„			2	11
Circles 22 S.W.G.	„			3	2½
Circles 18 S.W.G.	„			3	1½
Circles 12 S.W.G.	„			3	0½
Plate as rolled	„			2	8
Sections	„			3	2
Wire 10 S.W.G.	„			2	11½
Tubes 1 in. o.d. 16 S.W.G.	„			4	1

		£	s.	d
Aluminium Alloys				
BS1470. HS10W.	lb.			
Sheet 10 S.W.G.	„		3	1
Sheet 18 S.W.G.	„		3	3½
Sheet 24 S.W.G.	„		3	11
Strip 10 S.W.G.	„		3	1
Strip 18 S.W.G.	„		3	2½
Strip 24 S.W.G.	„		3	10½
BS1477. HP30M.				
Plate as rolled	„		2	11
BS1470. HC15WP.				
Sheet 10 S.W.G.	„		3	9½
Sheet 18 S.W.G.	„		4	2
Sheet 24 S.W.G.	„		5	0½
Strip 10 S.W.G.	„		3	10½
Strip 18 S.W.G.	„		4	2
Strip 24 S.W.G.	„		4	9½
BS1477. HPC15WP.				
Plate heat treated	„		3	6½
BS1475. HG10W.				
Wire 10 S.W.G.	„		3	10½
BS1471. HT10WP.				
Tubes 1 in. o.d. 16 S.W.G.	„		5	0½
BS1476. HE10WP.				
Sections	„		3	1½
Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9
Brass Tubes	„		1	11½
Brazed Tubes	„		—	
Drawn Strip Sections	„		—	
Sheet	ton		—	
Strip	„	245	15	0
Extruded Bar	lb.		1	11½
Extruded Bar (Pure Metal Basis)	„		—	
Condenser Plate (Yellow Metal)	ton	182	0	0
Condenser Plate (Naval Brass)	„	193	0	0
Wire	lb.		2	7
Copper Tubes	lb.		2	2
Sheet	ton	249	5	0
Strip	„	249	5	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	270	15	0
Cupro Nickel				
Tubes 70/30	lb.		3	6
Lead Pipes (London)	ton	112	5	0
Sheets (London)	„	110	0	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Sheet and Strip 7%	lb.		3	6½
Wire 10%	„		4	1½
Phosphor Bronze				
Wire	„		3	11½
Titanium (1,000 lb. lots)				
Billet over 4″ dia.-18″ dia.	lb.	63/-		64/-
Rod 4″ dia.-·250″ dia.	„	75/-		112/-
Wire under ·250″ dia.-·036″ dia.	„	146/-		222/-
Sheet 8′×2′×·250″-·010″ thick	„	88/-		157/-
Strip ·048″-·003″ thick	„	100/-		350/-
Tube (representative gauge)	„			300/-
Extrusions	„			120/-
Zinc Sheets, English destinations	ton	111	5	0
Strip	„		nom.	

Financial News

Light Metal Statistics

Figures showing the U.K. production, etc., of light metals for Oct., 1958, have been issued by the Ministry of Supply as follow (in long tons):—

Virgin Aluminium

Production	2,117
Imports	22,210
Despatches to consumers	20,408

Secondary Aluminium

Production	10,318
Virgin content of above	885
Despatches (including virgin content)	10,240

Secondary in Consumption (per cent)

Wrought products	5·5
Cast products	83·3
Destructive uses (aluminium content irrecoverable)	63·0
Total consumption	27·6

Scrap

Arisings	14,622
Estimated quantity of metal recoverable	10,100
Consumption by:	
(a) Secondary smelters	13,326
(b) Other users	1,431

Despatches of wrought and cast products

Sheet, strip and circles	12,835
Extrusions (excluding forging bar, wire-drawing rod and tube shell):	
(a) Bars and sections	3,130
(b) Tubes (i) extruded	269
(ii) cold drawn	648
(c) (i) Wire	2,199
(ii) Hot rolled rod (not included in (c) (i))	66
Forgings	304
Castings: (a) Sand	1,955
(b) Gravity die	3,762
(c) Pressure die	1,607
Foil	2,239
Paste	286

Magnesium Fabrication

Sheet and strip	12
Extrusions	108
Castings	135
Forgings	17

LIGHT METALS STATISTICS IN JAPAN
(October, 1958)

Classification	Production	Shipment	Stock	Export
Alumina	21,842	23,854	13,544	8,856
Aluminium				
Primary	7,998	7,382	3,472	3
Secondary	2,047	2,074	275	0
Rolled Products	6,003	6,058	1,893	412
Electric Wire	616	675	944	431
Sheet Products	1,493	1,464	1,179	71
Castings	1,639	—	—	—
Die-Castings	968	—	—	—
Forgings	18	—	—	—
Powder	—	—	—	—
Primary Aluminium (November)	7,812	7,512	3,772	0
Sponge				
Titanium	161	192	712	183
Magnesium	85	32	3	0
Secondary	188	199	280	0

Morgan Crucible Co. Ltd.

The directors of the company have raised the interim dividend from 3¾ per cent to 5 per cent. This is stated to have been done in order, "primarily," to make the interim and final payments more even. The final dividend last year was 6¼ per cent.

An Optical Deal

The capital of C. Baker of Holborn, an optical instrument manufacturer, is reported to have been purchased by Cooke, Troughton and Simms, a member of the Vickers Group. The name of the company will, it is said, be changed to C. Baker Instruments.

David Brown Corpn.

Group net profit, year to June 30, 1958, £234,334 (£177,750). No dividend (same). Current assets £10,386,732 (£9,296,858), liabilities £6,397,572 (£5,843,538). Reserves and surplus £4,309,096 (£3,631,373,) future tax £560,200 (£738,245). Capital commitments £340,000 (£220,000).

Wright, Bindley and Gell

Group profit for the period September 29, 1957, to September 27, 1958, was £90,931 (£94,123), before tax. The dividend is unchanged at 20 per cent. Fixed assets of £321,643 compare with £303,684, and current assets of £432,031 with £436,570. Current liabilities of £241,861 (£260,727) include an overdraft of £57,115 (£87,479). Capital commitments are approximately £25,300 (£14,000).

An Acquisition

It is reported that Newman Hender and Co. have acquired the capital of the Humber Brass and Copper Works. This concern undertakes all types of non-ferrous work, including the fabrication of copper and aluminium vessels for many industries. The works are at Hull.

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.

Cadmium (Liverpool) Limited (615896), 68 Gloucester Street, Liverpool, 3. Registered December 1, 1958. To carry on business of cadmium platers, etc. Nominal capital, £1,000 in £1 shares. Director: Gordon S. Fraser.

E. A. Barnes and Sons Ltd. (615898), Registered December 1, 1958. To take over business of metal merchants and scrap metal dealers carried on as "E. A. Barnes and Sons" at 28 Rotten Row, Lichfield, Staffs., etc. Nominal capital, £20,000 in £1 shares. Directors: Arthur E. Barnes and Mrs. Dorothy A. Barnes.

Scrap Metal Prices

Merchants' average buying prices delivered, per ton, 6/1/59.

	£
Aluminium	
New Cuttings	142
Old Rolled	120
Segregated Turnings	90
Brass	
Cuttings	142
Rod Ends	135
Heavy Yellow	108
Light	103
Rolled	132
Collected Scrap	106
Turnings	129
Copper	
Wire	195
Firebox, cut up	187
Heavy	182
Light	177
Cuttings	195
Turnings	174
Braziery	148
Gunmetal	
Gear Wheels	173
Admiralty	173
Commercial	150
Turnings	145
Lead	
Scrap	61
Nickel	
Cuttings	—
Anodes	500
Phosphor Bronze	
Scrap	150
Turnings	145
Zinc	
Remelted	53
Cuttings	41
Old Zinc	31

The latest available scrap prices quoted on foreign markets are as follow. (The figures in brackets give the English equivalents in £1 per ton):—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£184.0.0)	210
Heavy copper	(£184.0.0)	210
Light copper	(£153.7.6)	175
Heavy brass	(£105.2.6)	120
Light brass	(£83.5.0)	95
Soft lead scrap	(£58.12.6)	67
Zinc scrap	(£38.10.0)	44
Used aluminium unsorted	(£87.12.6)	100
France (francs per kilo):		
Copper	(£176.5.0)	235
Heavy copper	(£176.5.0)	235
Light brass	(£116.5.0)	155
Zinc castings	(£50.5.0)	67
Lead	(£70.10.0)	94
Tin	—	
Aluminium	(£101.5.0)	135
Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£197.12.6)	335
Aluminium copper alloy	(£126.17.6)	215
Lead, soft, first quality	(£82.12.6)	140
Lead, battery plates	(£47.5.0)	80
Copper, first grade	(£203.10.0)	345
Copper, second grade	(£191.15.0)	325
Bronze, first quality machinery	(£200.12.6)	340
Bronze, commercial gunmetal	(£171.2.6)	290
Brass, heavy	(£138.12.6)	235
Brass, light	(£126.17.6)	215
Brass, bar turnings	(£129.17.6)	220
New zinc sheet clippings	(£59.0.0)	100
Old zinc	(£44.5.0)	75

THE STOCK EXCHANGE

A Reaction Occurred Throughout Industrial Market And Business Not Quite So Active

ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 6 JANUARY	+RISE —FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1958 HIGH	1958 LOW	1957 HIGH	1957 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	24/3	+4½d.	9	10	7 8 6	24/9	17/6	28/3	18/–
400,000	2/–	Anti-Attrition Metal	1/7½		4	8½	4 18 6	1/9	1/3	2/6	1/6
38,305,038	Stk. (£1)	Associated Electrical Industries ...	56/9		15	15	5 5 9	58/9	46/6	72/3	47/9
1,590,000	1	Birfield	59/3	+2/3	15	15	5 1 3	62/4½	46/3	70/–	48/9
3,196,667	1	Birmid Industries	75/6	+4/–	17½	17½	4 12 9	77/6	55/3	80/6	55/9
5,630,344	Stk. (£1)	Birmingham Small Arms	39/9	+2/3	11	10	5 10 9	39/–	23/9	33/–	21/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/–		5	5	6 13 3	16/1½	14/7½	16/–	15/–
350,589	Stk. (£1)	Ditto Cum. B. Pref. 6%	17/9	+7½d.	6	6	6 15 3	17/4½	16/6	19/–	16/6
500,000	1	Bolton (Thos.) & Sons	26/9		10	12½	7 9 6	28/9	24/–	30/3	28/9
300,000	1	Ditto Pref. 5%	15/–		5	5	6 13 3	16/–	15/–	16/9	14/3
160,000	1	Booth (James) & Co. Cum. Pref. 7%	20/6	+1/6	7	7	6 16 6	20/4½	19/–	22/3	18/9
9,000,000	Stk. (£1)	British Aluminium Co.	79/6	—1/9	12	12	3 0 3	84/–	36/6	72/–	38/3
1,500,000	Stk. (£1)	Ditto Pref. 6%	19/6		6	6	6 3 0	20/–	18/4½	21/6	18/–
15,000,000	Stk. (£1)	British Insulated Callender's Cables	50/9	—1/6	12½	12½	4 18 6	52/6	38/9	55/–	40/–
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	50/–		10	10	4 0 0	52/–	28/3	39/–	29/6
600,000	Stk. (5/–)	Canning (W.) & Co.	25/6	+1/–	25+ *2½C	25	4 18 0	25/3	19/3	24/6	19/3
60,484	1/–	Carr (Chas.)	1/4½	+1½d.	12½	25	10 0 0	2/3	1/4½	3/6	2/1½
150,000	2/–	Case (Alfred) & Co. Ltd.	5/–	+3d.	25	25	10 0 0	5/3	4/–	4/6	4/–
555,000	1	Clifford (Chas.) Ltd.	22/6	+6d.	10	10	8 17 9	22/–	16/–	20/6	15/9
45,000	1	Ditto Cum. Pref. 6%	15/3		6	6	7 17 6	16/–	15/–	17/6	16/–
250,000	2/–	Coley Metals	3/–		20	25	13 6 9	4/6	2/6	5/7½	3/9
8,730,596	1	Cons. Zinc Corp.†	64/3	+4/9	18½	22½	5 16 9	65/3	41/–	92/6	49/–
1,136,233	1	Davy & United	87/–	+1/–	20	15	4 12 0	87/–	45/9	60/6	42/6
2,750,000	5/–	Delta Metal	25/3	+3d.	30	*17½	5 18 9	25/–	17/7½	28/6	19/–
4,160,000	Stk. (£1)	Enfield Rolling Mills Ltd.	37/–		12½	15B	6 15 3	38/–	22/9	38/6	25/–
750,000	1	Evered & Co.	30/–		15Z	15	6 13 3	30/–	26/–	52/9	42/–
18,000,000	Stk. (£1)	General Electric Co.	38/9	—6d.	10	12½	5 3 3	40/6	29/6	59/–	38/–
1,500,000	Stk. (10/–)	General Refractories Ltd.	37/9	+6d.	20	17½	5 6 0	39/3	27/3	37/–	26/9
401,240	1	Gibbons (Dudley) Ltd.	66/6		15	15	4 10 3	67/6	61/–	71/–	53/–
750,000	5/–	Glacier Metal Co. Ltd.	7/–	+3d.	11½	11½	8 4 3	8/3	5/–	8/1½	5/10½
1,750,000	5/–	Glynwed Tubes	16/1½		20	20	6 4 0	18/1½	12/10½	18/–	12/6
5,421,049	10/–	Goodlass Wall & Lead Industries ...	30/–	—3d.	13‖	18Z	4 6 9	30/9	17/3	37/3	28/9
342,195	1	Greenwood & Batley	57/6		20	17½	6 19 3	57/9	45/–	50/–	46/–
396,000	5/–	Harrison (B'ham) Ord.	15/–	—4½d.	*15	*15	5 0 0	15/9	11/6	16/9	12/4½
150,000	1	Ditto Cum. Pref. 7%	19/6		7	7	7 3 6	19/9	18/4½	22/3	18/7½
1,075,167	5/–	Heenan Group	7/10½		10	10‡	6 7 0	9/7½	6/9	10/4½	6/9
236,953,260	Stk. (£1)	Imperial Chemical Industries ...	36/9	—9d.	12Z	10	4 7 0	38/–	24/3	46/6	36/3
33,708,769	Stk. (£1)	Ditto Cum. Pref. 5%	16/6		5	5	6 1 3	17/1½	16/–	18/6	15/6
14,584,025	••	International Nickel	154½		$2.60	$3.75	3 0 3	169	132½	222	130
430,000	5/–	Jenks (E. P.), Ltd.	10/–	+3d.	14	27½♦	7 0 0	10/–	6/7½	18/10½	15/1½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/–		5	5	6 5 0	16/9	15/–	17/–	14/6
3,987,435	1	Ditto Ord.	45/6	—3d.	10	10	4 8 0	47/–	36/6	58/9	40/–
600,000	10/–	Keith, Blackman	25/9xcap	—2/–	17½E	15	6 16 0	28/9	15/–	21/9	15/–
160,000	4/–	London Aluminium	5/9	—3d.	10	10	6 19 3	6/–	3/–	6/9	3/6
2,400,000	1	London Elec. Wire & Smith's Ord. ...	73/6	+1/9	12½	12½	3 8 0	74/–	39/9	54/6	41/–
400,000	1	Ditto Pref.	24/9	+9d.	7½	7½	6 1 3	24/3	22/–	25/3	21/9
765,012	1	McKechnie Brothers Ord.	43/3	—1/9	15	15	6 18 9	45/–	32/–	48/9	37/6
1,530,024	1	Ditto A Ord.	43/–	—2/–	15	15	6 19 6	45/–	30/–	47/6	36/–
1,108,268	5/–	Manganese Bronze & Brass	14/–	+3d.	20	27½‡	7 2 9	14/1½	8/9	21/10½	7/6
50,628	6/–	Ditto (7½% N.C. Pref.)	6/–		7½	7½	7 10 0	6/3	5/6	6/6	5/–
13,098,855	Stk. (£1)	Metal Box	69/3	—2/9	11	11	3 3 6	73/3	40/6	59/–	40/3
415,760	Stk. (2/–)	Metal Traders	9/–	+3d.	50	50	11 2 3	9/–	6/3	8/–	6/3
160,000	1	Mint (The) Birmingham	22/–	+1/–	10	10	9 1 9	22/9	19/–	25/–	21/6
80,000	5	Ditto Pref. 6%	70/6		6	6	8 10 3	83/6	69/–	90/6	83/6
3,705 670	Stk. (£1)	Morgan Crucible A	44/6	+1/–	10	10	4 10 0	45/–	34/–	54/–	35/–
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref.	18/–	+3d.	5½	5½	6 2 3	18/–	17/–	19/3	16/–
2,200,000	Stk (£1)	Murex	45/3xd	—1/6	17½	20	7 14 9	58/9	46/–	79/9	57/–
468,000	5/–	Ratcliffs (Great Bridge)	11/–		10	10	4 11 0	11/1½	6/10½	8/–	6/10½
234,960	10/–	Sanderson Bros. & Newbould ...	27/3		20	27½D	7 6 9	27/3	24/6	41/–	24/9
1,365,000	Stk. (5/–)	Serck	18/9	+1½d.	15	17½	4 0 0	18/7½	11/–	18/10½	11/6
6,698,586	Stk. (£1)	Stone-Platt Industries	45/3	+9d.	15	12½	6 12 6	45/6	22/6	33/4½	22/7½
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	16/3	+6d.	5½	5½	6 15 6	16/3	12/7½	14/–	12/9
14,494,862	Stk. (£1)	Tube Investments Ord.	74/3	—10/6	17½	15	4 14 3	86/–	48/4½	70/9	50/6
41,030,000	Stk. (£1)	Vickers	35/9	+9d.	10	10	5 11 9	36/3	28/9	46/–	29/–
750,000	Stk. (£1)	Ditto Pref. 5%	15/–		5	5	6 13 3	15/9	14/3	18/–	14/–
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	22/6		*5	*5	6 18 0A	23/–	21/3	24/9	20/7½
2,200,000	1	Ward (Thos. W.), Ord.	86/–	+1/–	20	15	4 13 0	87/3	70/9	83/–	64/–
2,666,034	Stk. (£1)	Westinghouse Brake	46/–	+6d.	10	18P	4 7 0	46/6	32/6	85/–	29/1½
225,000	2/–	Wolverhampton Die-Casting ...	8/10½	—1½d.	30	25	6 15 3	10/1½	7/–	10/1½	7/–
591 000	5/–	Wolverhampton Metal	22/3	+1/–	27½	27½	6 3 6	22/9	14/9	22/3	14/9
78,465	2/6	Wright, Bindley & Gell	5/3		20	20	9 10 6	5/4½	2/9	3/9	2/7½
124,140	1	Ditto Cum. Pref. 6%	13/–		6	6	9 4 6	13/–	11/3	12/6	11/3
150,000	1/–	Zinc Alloy Rust Proof	2/10½		27	40D	9 7 9	3/1½	2/7½	5/–	2/9

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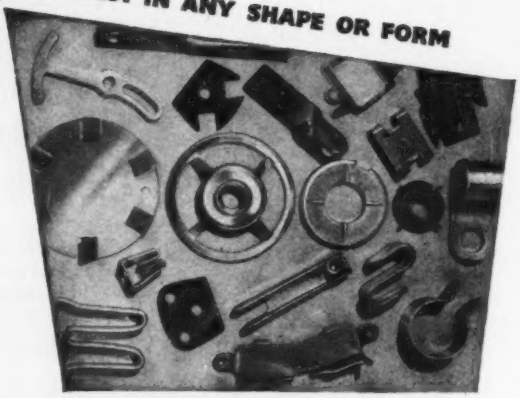

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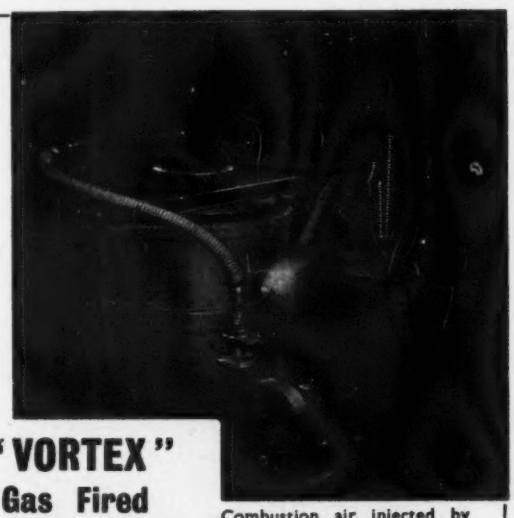

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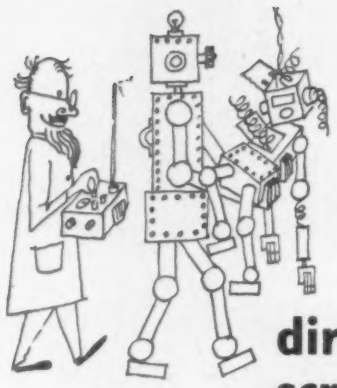

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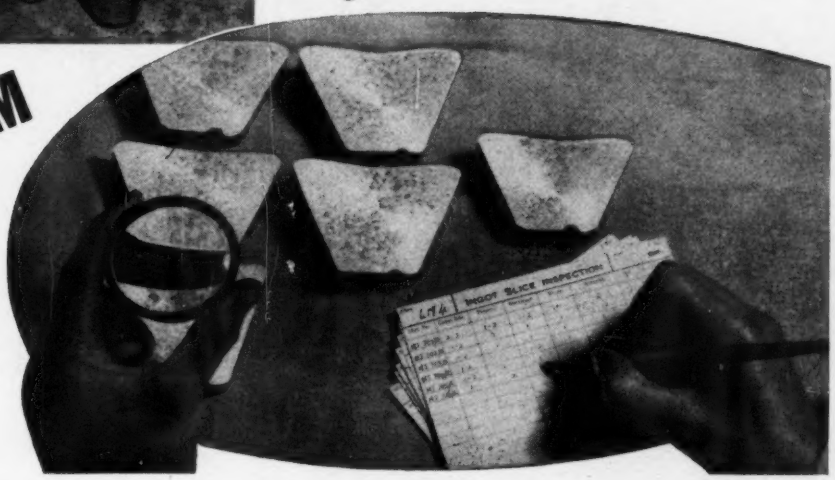

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Photo: The Times Review of Industry

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